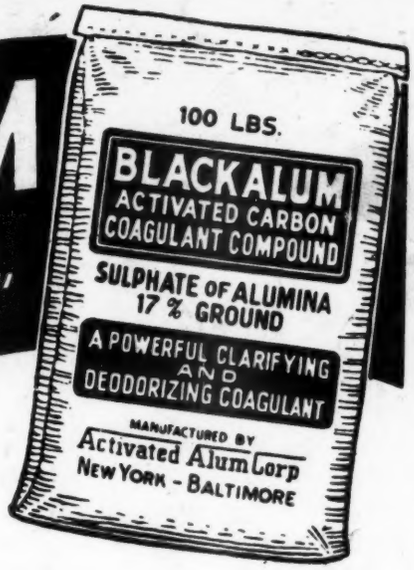
NOVEMBER
1946

IN THIS ISSUE:
Mathematical Priority Rating for Road Construction
Miami Solves Its Sewerage Problems
Laboratory Study of Break-point Chlorination

Public Works Magazine

BLACKALUM

AMERICA'S MOST POWERFUL WATER WORKS COAGULANT"



and ACTIVATED ALUM

BLACKALUM is a powerful deodorizing and decolorizing coagulant. It contains powdered activated carbon. Alumina content over 17%. It provides maximum economy with greatest efficiency.

Activated Blackalum prevents fermentation of sludge in basins. Fast flocing over a wide pH range. It is particularly effective for summer coagulation. It removes tastes from water supplies.

By the use of Blackalum, troubles resulting from red water are successfully eliminated.

Due to its powerful deodorizing and decolorizing properties, waterworks engineers claim that Blackalum is exceptionally economical.

PALMER FILTER BED AGITATORS *insure*

Longer filter runs
Requires an average of 40% less wash water
Completely eliminates mud balls
Eliminates cracking or shrinking of the beds
Produces "new" sand after 3 weeks operation
Turns out purer, better tasting water
Low installation cost
No operating cost
More water through the filters
Less "time out" washing filters

Write for Bulletin No. 38

AUTOMATIC WATER SAMPLERS

End guesswork or delayed warnings. Enable you to know first and quickly just the kind of water you are pumping into distribution system. Various sizes. Simple, compact, economical. Write today for descriptive folder.

•

COMING! ELECTRONIC PURIFICATION

Wait for the new *electronic* method of water purification. Watch for forthcoming announcements of this revolutionary process.

PROMPT DELIVERIES ON ALL PRODUCTS
FOR FULL INFORMATION ADDRESS—

STUART-BRUMLEY CORP.

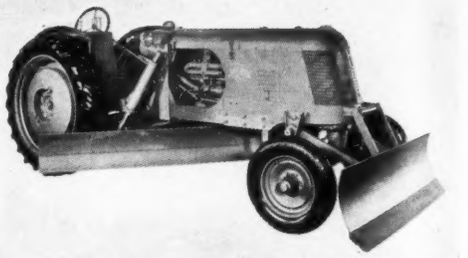
516 N. CHARLES ST. BALTIMORE-1, MD.

FOR 5 IMPORTANT REASONS

Huber 3-Wheel Rollers are available in 3, 4, 5, 10, and 12 ton sizes.

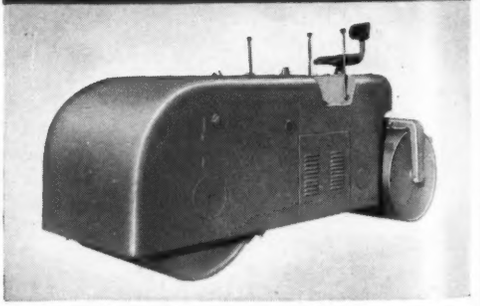
IT PAYS TO PUT ALL OF YOUR ROAD MACHINERY PURCHASES IN "ONE Basket"

The Huber Maintainer is a versatile machine to make short work of road and airport maintenance.



- Huber has the EXPERIENCE of many years standing, so essential in building dependable road machinery.
- Huber has the KNOWLEDGE important to cope intelligently with road building and maintenance problems and to prescribe for an economical solution.
- Huber offers a COMPLETE LINE of 3-wheel Road Rollers and Tandem Rollers and a Maintainer that is eight machines in one.
- Huber's manufacturing FACILITIES are "geared" to meet maximum demand, once material shortages are licked.
- Huber's splendid distributor organization, strategically spotted throughout the country, joins the company in preserving its policy of UNDIVIDED RESPONSIBILITY.

Huber Variable Weight Tandem Rollers are built in 3, 4, 5, 9, and 12 ton capacities.



THE HUBER MFG. COMPANY • MARION, OHIO, U. S. A.

HUBER

3 Wheel • Tandem

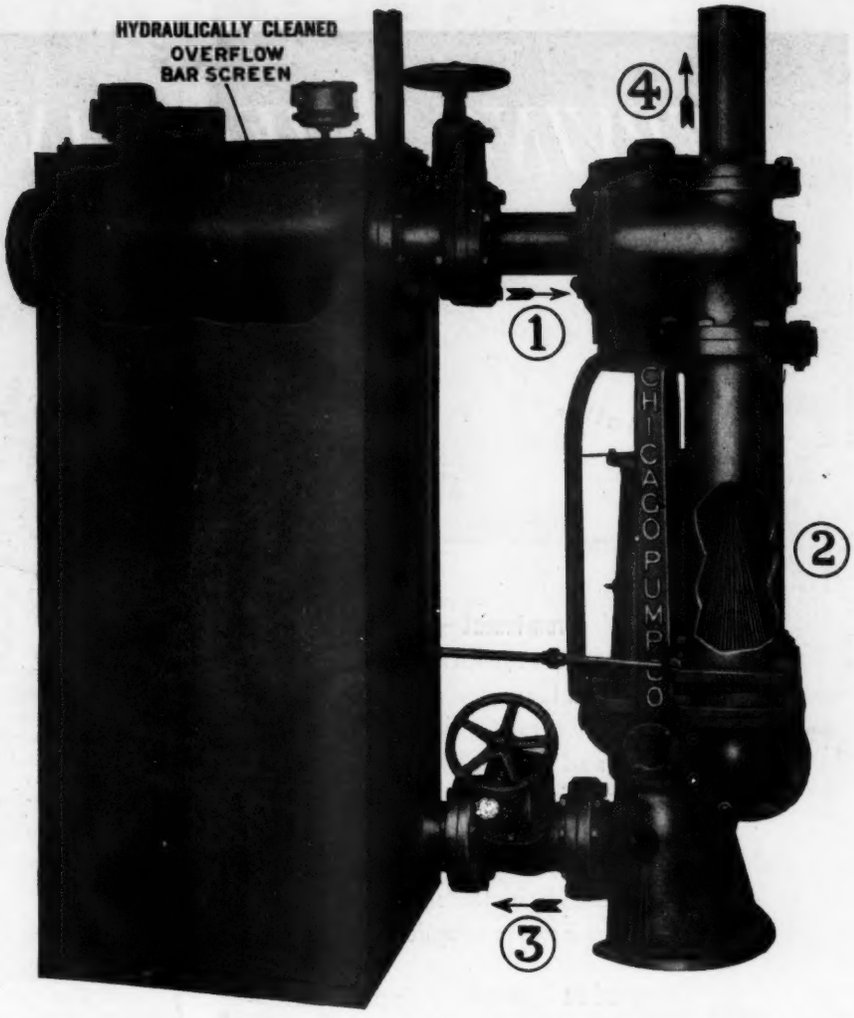
ROAD ROLLERS MAINTAINERS

NEW FLUSH-KLEEN DEVELOPMENT

SINGLE "PACKAGED" UNIT

CLOG-PROOF SEWAGE PUMP FOR SMALL OUTLYING LIFT STATIONS 50 GPM OR LESS

(Standard Duplex Flush-Kleens Installed for Larger Flows)



Thoroughly dependable. Requires no attention, except periodic lubrication.

Cannot clog, because sewage solids do not reach pump impeller.

Overall dimensions only 4' 10⅛" x 2' 2⅝".

Second unit can be added any time, to make a duplex installation, by dividing the flow with a Y-fitting.

Water-tight tank prevents leakage.

Pump discharges 75 to 100 GPM to assure rapid cycle of operation to keep strainer clean.

Economical in first cost and high in efficiency.

Ask for Bulletin 122-S.

FILLING WET WELL

① Sewage flows through inlet pipe.
② Sewage solids are retained by strainer.
③ Strained sewage flows through idle pump to basin.

PUMPING

③ Strained sewage is pumped from basin.
② Sewage solids are backwashed from strainer.
④ Special check valve closes; sewage and solids are pumped to sewers.

NOTABLE, EXCLUSIVE CONTRIBUTIONS TO SEWAGE TREATMENT

"PACKAGE" PLANTS
SWING DIFFUSERS
COMMINUTORS
FLUSH-KLEENS
SCRU-PELLERS

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

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Flush Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

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NOVEMBER, 1946

SERVING AMERICAN INDUSTRY

NaF
NaHF₂

GENERAL CHEMICAL SODIUM FLUORIDES

From insect extermination to rimming steel operations . . . from commercial laundry work to etching glass—General Chemical Sodium Fluoride and Sodium Bifluoride serve industry in many ways. Today, they are filling new roles, too, such as the use of Sodium Fluoride for public health research in the fluorination of domestic water supplies.

Ahead lie still other applications—perhaps one in your plant or process. If so, speed your investigations by contacting the nearest General Chemical office for pertinent product data as well as for technical service in adapting either of these fluorides to your needs.

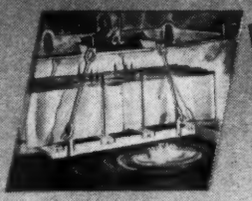
These General Chemical Fluorine Compounds are available from convenient shipping points in the following strengths and densities: Sodium Fluoride, White—Light or Dense, 90% and 95% NaF, also Nile Blue—Light, 95% NaF; Sodium Bifluoride, Powdered, 90% $NaHF_2$.

SODIUM FLUORIDE

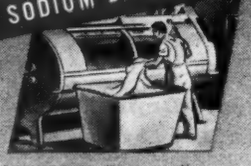
RIMMING STEEL: Used in pouring billets to insure a smooth rolled sheet

WOOD PRESERVATIVE: To prevent insect attack on structural and other materials

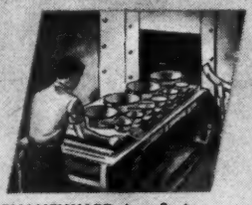
SODIUM BIFLUORIDE



STAINLESS STEEL: As a Hydrofluoric Acid substitute in pickling



LAUNDRIES: To neutralize excesses of soap and other alkaline detergents; to remove iron stains



ENAMELWARE: As a fluxing agent

GLASS: As an etching and frosting agent

PEST EXTERMINATION: As a vermin destroyer

MAINTENANCE: In cleaning stone and concrete surfaces

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GENERAL CHEMICAL COMPANY
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When you need special information—consult the classified **READERS' SERVICE DEPT.**, *pages 77-81*

BOOK REVIEW

Airport Planning. Charles Froesch, chief engineer, Eastern Air Lines, Inc., and Walther Prokosch, architect, Eastern Air Lines, Inc. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. New York. 1946. 250 pp. illus., diagrams, charts, maps, tables. $7.00.

This book discusses: the airport and the community; present and future aircraft; airway and airport traffic control; airport types; fundamental airport requirements; airfield planning and construction; airport lighting; airport building design; hangar design; special services such as refueling facilities, fire protection and control; modernization of existing facilities; airline terminals; and seaplane bases.

Landing facilities built today must be planned liberally because they will, of necessity, outlive any type of aircraft design for which they are created. Any airport or landing facility must meet four fundamental conditions: 1. It must be planned broadly and comprehensively; 2. It must be designed functionally and practically; 3. It must be constructed soundly at reasonable cost; 4. It must be administered economically. Each landing facility must be conceived of as a part of a well-integrated system of air activities to provide bases for national defense, in case of military emergencies, airports for commercial air transportation and flying the mail, or landing facilities for the personal flyer.

Requirements that must be met to satisfy the development of any sound landing facility are: flexibility of plan; accessibility, adequate size; freedom from obstructions; proper zoning; favorable meteorological conditions; availability of utilities; proper balance between airfield and buildings.

The airport authority should examine the financial aspects of the entire airport project from the beginning of the design to the completion of the final stages. A rough estimate should be made of the cost of acquiring the necessary land and the cost of constructing the complete runway system and buildings. The next step is to determine how the necessary funds are to be raised and what financial assistance can be expected from federal and/or state governments in order to arrive at the total sum to be raised locally and the annual carrying charges. Maintenance and operating costs should be determined. These costs together with the carrying charges and amount of principal to be amortized each year form the sum total to be met by airport revenue and community assessments.

A complete master plan of the proposed airport should then be prepared embodying an evaluation of all the foregoing fundamental and specific requirements and the reasons which led to the conclusions reached. It should show a plan of the selected site as it exists and as planned by stages.

Reviewed by:

The Bureau of Urban Research

PUBLIC WORKS

Founded in 1896

Devoted to the interests of the engineers and technical officials of cities, counties and states

Vol. 77 No. 11

W. A. HARDENBERGH and A. PRESCOTT FOLWELL

Editors

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The Editor's Page

A Statement by Public Works Magazine

Some of our readers have written us, questioning a publication which has closely copied our name. Despite the unfortunate similarity of names, against which we have protested, there is absolutely no connection or relationship.

Aspects of Our Post-War Problems in the Public Works Field

It is interesting to speculate on our present problems; and it is perhaps valuable to look at them in the light of what might have been. Everyone, during the war, looked forward to problems of reconversion, but in a good many, if not most, cases those we have are not what we expected. If one has a moderate degree of optimism in his make-up, there is little reason for discouragement—impatience, surely, but nothing worse.

Our public works market is not vanishing; it looks better for the future than it ever has in the past. There is plenty of business in the public works field to provide a prosperous market for at least ten years to come; but some of us are getting into a dither because it isn't waiting on our doorstep right now. In the meantime, we are having trouble getting parts, equipment, personnel and plenty of other things; but no one is starving and just about no one is going broke.

After more than four years of war, we can't expect to escape without some hangover. We may well be thankful that it isn't worse than it is, and that it involves, at the most, a delay in full production, and little real hardship. Our markets are not being gobbled up by another nation; they will be here for years to come, and bigger and better. It is good for us to be dissatisfied, and to crab to a reasonable extent, but there is no reason to be gloomy. There's not much wrong that a few orders and a couple of steaks won't cure.

Studies of Army Sewage Treatment

The Army made an excellent record in sewage treatment during World War II, utilizing modern methods of equipment, employing skilled engineers for design, and providing good operation. When the war began, there were little data of any sort on which to base design of military sewage disposal facilities. Flow volume of sewage, its organic and grease content, and its treatability were unknown. In order that, if another emergency should occur, we would not again be caught without any background of recorded experience, the National Research Council was requested to undertake an intensive study and report on military sewage treatment facilities. This study was made by the Sanitary Engineering Committee of the Council, and the report has now been published.

In addition to its potential value to the military should another emergency arise, this study should contribute a great deal of practical information to those engaged in the design and operation of municipal sewage treatment plants. In fact, this consideration has much weight in planning the study.

From the large number of Army plants, the committee was able to select those that were representative of the various types of treatment and that had relatively long and adequate records of operation. Unfortunately, most of the better records covered that period of time when the troop population in the United States had decreased due to overseas assignments, and many of the plants reported on were therefore not fully loaded.

The publication of this report presented a problem, due to its many charts and tables and to its more than 300 pages of text. The Federation of Sewage Works Associations volunteered to publish it and has done so. Thanks are due them for this material contribution, which resulted in prompt publication of a valuable and useful document.

Reader Reactions to Our On-The-Job Training Program

We do not often print the nice things that our readers write to us, but we cannot forbear a general statement of thanks to our readers for the very generous comments we have received from them regarding our On-The-Job Training Program article on pages 29 to 44 of the September issue. It appears to have met a real and general need; we hope that it will benefit hundreds of our readers.

Some time this winter and next spring, we expect to treat two other segments of the public works field with similar articles covering street and highway construction and maintenance and water supply and purification. We hope that they will be as useful to as many as our first article.

An Excellent and Timely Report From Lewiston

An editor gets a little hardened to official reports from cities, counties, states and federal agencies. Usually they are horribly late; they are dry and uninteresting, and they have the appeal that one expects from any official tabulation of musty statistics.

The report from the city of Lewiston, Idaho, W. P. Hughes, city engineer, is a commendable exception to the general rule. It reached us within three months of the end of the fiscal year; in appearance it is one of the best we have seen; and it was interesting enough to read through carefully. Congratulations to Lewiston and to Mr. Hughes for this fine report, which covers the activities of the Engineering, Park, Cemetery, Water and Street Departments.

Tuberculosis and the Christmas Seal Sale

Tuberculosis is preventable, and also curable, but it costs money for either. Basic factors in prevention are good housing and better living conditions, and these our cities should do their utmost to provide for the future, thus reducing the incidence of this No. 1 disease killer among young adults. There are also other factors in prevention, as education and early care of the sick; and cure is important. The great work of the National Tuberculosis Association is based on the money that it gets from the annual sale of Christmas Seals. We hope that our readers will help.

P-u-r-r-s like a kitten
KICKS like a mule

You've never seen an air compressor as quiet, cool and easy-running as the Jaeger "AIR PLUS." Precision built and balanced, like the fine engines with which they're powered,* these modern compressor units function at far slower piston speed and lower temperatures, produce more air with every pound of fuel and will out-last their original power plants 3-to-1. For LOWEST COST AIR (based on reduced fuel consumption, minimum upkeep and far longer compressor life), equip with "AIR PLUS" in any size from 60 to 500 cu. ft.

*(*Continental, Caterpillar and International engines standard.)*

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Ask your Jaeger distributor to show you these and many other "AIR PLUS" features: 75% to 100% bigger, "ultra-lapped" valves — 20% to 30% slower, long-life piston speed (only 800 f.p.m.) — 100% positive force-feed lubrication—100% efficient intercooling—30% to 50% larger air receivers — bigger tool boxes, lifetime clutches, sectional radiators and intercoolers, grouped controls, electric starters are standard. Timken-bearing trailer or truck or tractor mounting to meet your needs.

Ask for Catalog JC-5, the up-to-date-buyer's guide.

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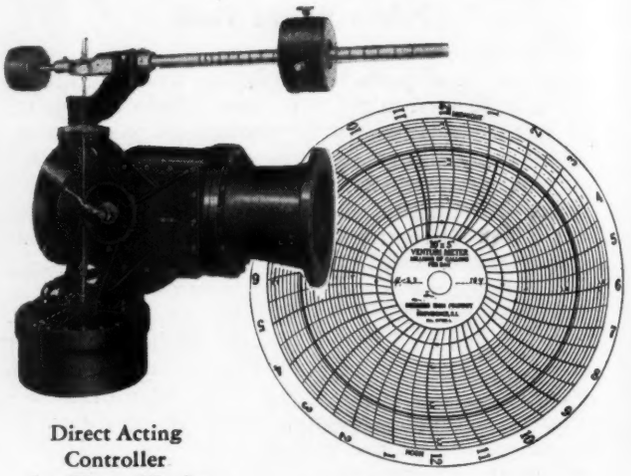
AIR COMPRESSORS, MIXERS, PUMPS, HOISTS, PAVING MACHINERY, TRUCK MIXERS—DISTRIBUTORS IN 120 CITIES

Look to a Thoroughbred for
PERFECT CONTROL



Direct Acting Controller for Water Works

Reduced from actual chart.

PERFECT RATE CONTROL BECAUSE

Annular pressure-averaging chamber measures the flow more accurately. Superior design avoids air pockets — no hunting. Balanced control valve responds to slightest change in flow. Every bearing is of the anti-friction type — no balancing links or pivots.

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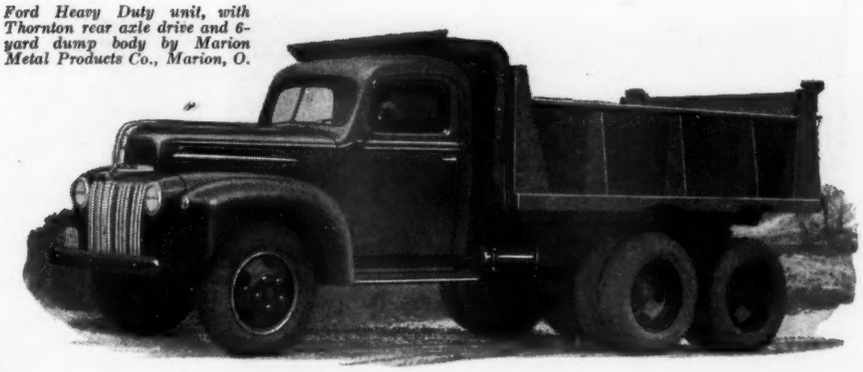
REGISTRATIONS *SHOW* IT—OPERATORS *KNOW* IT!

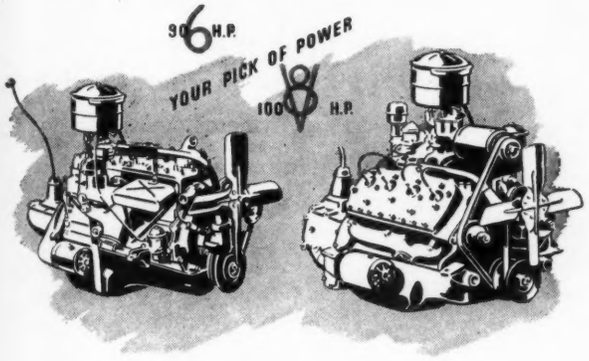
"FORD TRUCKS LAST LONGER!"

Ford Heavy Duty unit, with Thornton rear axle drive and 6-yard dump body by Marion Metal Products Co., Marion, O.



One big reason—

FORD ENGINES STAND UP!



Ford Truck engines—either the famous 100-H.P. V-8 or the extra-thrifty 90-H.P. Six—are world-famous for endurance in severe service. Here are some reasons why: They're of time-proved L-head type, quiet, simple, efficient—hardened valve seat inserts resist pounding and pitting—precision-set valves need no adjusting—valve springs are shot-peened and rust-proofed for long life—Ford alloy cast steel crankshafts are balanced and counterbalanced for enduring smoothness—Flightlight aluminum alloy 4-ring pistons maintain good compression, save oil. Full pressure lubrication, with positive, large-capacity oil pumps, plus effective crankcase ventilation, scientifically correct cooling and efficient oil- and air-filtering, all prolong Ford engine life.

Ford

There are more than fifty such long-life features throughout Ford Truck engines and chassis. NO OTHER TRUCKS BRING YOU ALL THESE IMPORTANT PLUS VALUES AT ANY PRICE. It is the extra worth which Ford alone offers that makes Ford Trucks Last Longer. This extra value tells you clearly why 7 out of 11 of all Ford Trucks registered since 1928 are still in service—why more than half of all Ford Trucks on the job are at least nine years old!

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FORD TRUCKS

MORE FORD TRUCKS IN USE TODAY THAN ANY OTHER MAKE

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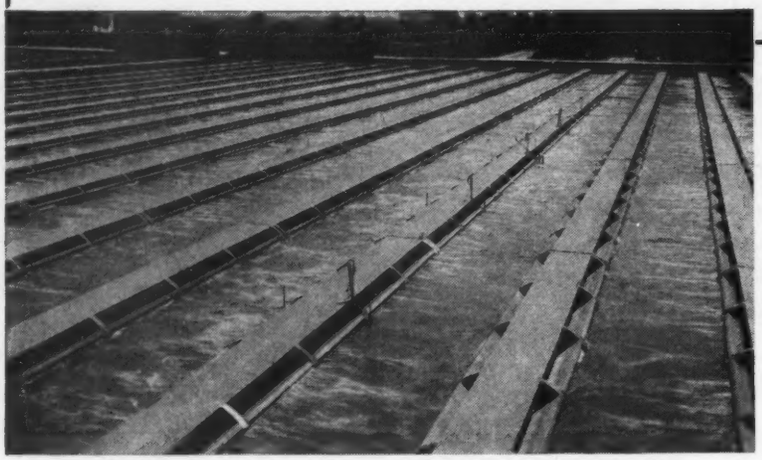
Performance in World's Largest Sewage Treatment Plant...

...leads to extended use of Everdur Electrical Conduit



Everdur Electrical Conduit serves the aeration and final settling tanks in bringing power from the operating galleries to the sluice gates at the control centers, and from these centers to the operating mechanism on the center pier of each tank.

General view of Southwest Sewage Treatment Works, Chicago, world's largest sewage plant.

Electrical tunnel, showing Everdur Electrical Conduit in course of installation. In all, 14 miles of such conduit were required.

WHEN Chicago's Southwest Sewage Treatment Plant was built ten years ago, a total of 14 miles of Everdur* Electrical Conduit, in sizes from ¾" to 2½", was installed... about 80,000 lb. of conduit and 20,000 lb. of fittings and boxes.

Conduit of Everdur Metal was selected because of its high physical properties and excellent resistance to many corroding agents. Today this Everdur Conduit is still giving excellent service where rustable conduit has failed. Additional Everdur Conduit has been ordered for early installation.

For detailed information on Everdur Copper-Silicon Alloys in Sewage and Water Works service, write for Publications E-11 and E-6. 46192

*Reg. U. S. Pat. Off.

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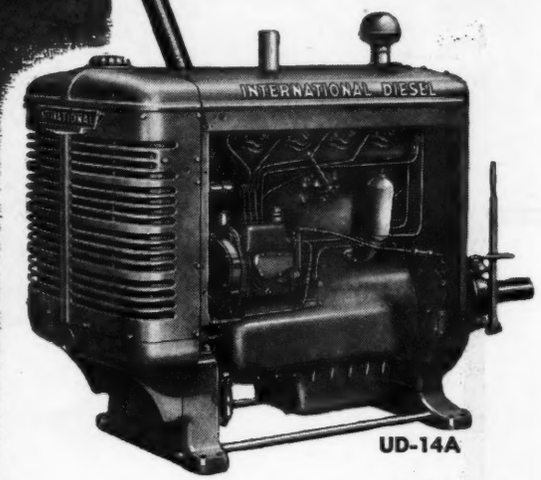
IH Presents

Another advance in INTERNATIONAL DIESEL POWER



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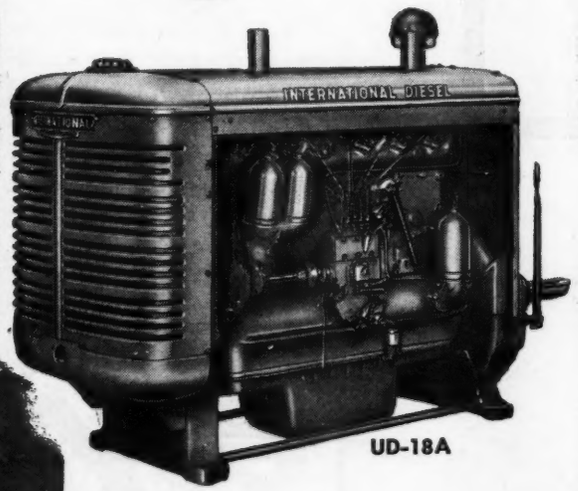

UD-18A

More Power! The horsepower of two models of International Diesel Power Units has been stepped up by 11% and 25% respectively —without increasing their size or weight— as the result of advanced engineering in the fuel combustion system. These are the 4-cylinder, 76-hp. UD-14A and 6-cylinder 125-hp. UD-18A Power Units. Power ratings are for *working* horsepower of the complete unit with fan, radiator and power take-off.

Greater Hang-on! When pulled down by overload, increased torque gives these Diesels greater "lug-ability." And they are built to take overloads in stride!

Better Operating Economy! Even with horsepower stepped up, these Diesels run cool under heavy loads and operate at new low cost per horsepower. A low rate of fuel consumption proves their efficiency.

Available Soon! Look for these newest International Diesels in the powered equipment soon available through your International Industrial Power Distributor. And ask him for the facts and figures on these models. He has them now.

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Right — Model 3GB
Rapid Reverse Winch

Gar Wood truck mounted Cranes with capacity from 3000 pounds to 10 tons are Full Powered and have varying boom lengths with 180° swing. Cranes are complete with all drive and mounting parts.

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For every Gar Wood Crane or Winch . . . and there's one built for *your* particular kind of rugged duty . . . is designed, engineered, and built to do the job with *maximum efficiency, greatest safety,* and *lowest upkeep.* That's why they make the toughest jobs *easy.* Finish jobs *faster.*

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It costs a lot of money to make any pump—especially if you want to be a leader, not a follower, and to build a pump so efficient, so dependable that it will be second to none.

You pay the expense of maintaining well-staffed laboratories for product investigation and research—for continuous search for high efficiencies, better applications—and for the thorough testing of your finished product.

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Finally, you've the problem of making it easy for your customers to reach you for sales, service and consultation; you must network the country with distribution centers manned by experts.

Yes, all this costs a lot of money. No wonder, then, that there are so few pump manufacturers with this valued background. Among them, Fairbanks-Morse is an unquestioned leader in all phases of liquid-moving service . . . For all pumping problems, first see your Fairbanks-Morse dealer or call at the nearest Fairbanks-Morse branch office.

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TO SUPPLY PLENTY OF WATER

Fleets of trucks (illustrated) are strategically located throughout United States.

Flexible crews are equipped to handle any pipe cleaning job. Flexible power unit is shown.

Flexible Pressure Tool utilizes pressure of fluid flowing through pipe.

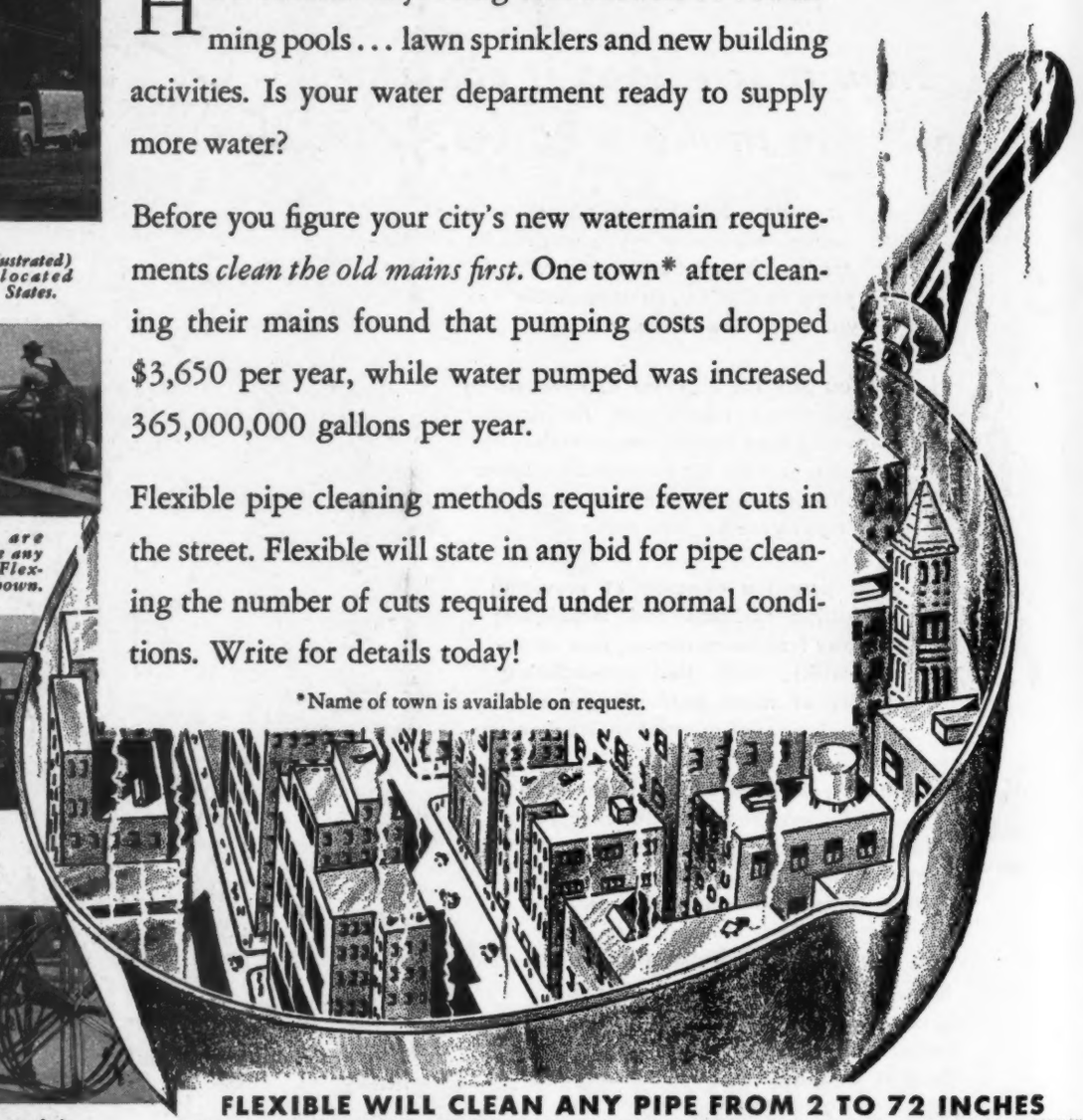
Centrifugal force throws chain head cutters in contact with pipe to remove tuberculation.

HOT summer days bring cold showers . . . swimming pools . . . lawn sprinklers and new building activities. Is your water department ready to supply more water?

Before you figure your city's new watermain requirements *clean the old mains first.* One town* after cleaning their mains found that pumping costs dropped $3,650 per year, while water pumped was increased 365,000,000 gallons per year.

Flexible pipe cleaning methods require fewer cuts in the street. Flexible will state in any bid for pipe cleaning the number of cuts required under normal conditions. Write for details today!

*Name of town is available on request.



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Returning veterans, working on jobs where motor trucks are purchased or used, just naturally go for GMC. For wherever they served . . . Africa or the Aleutians, Europe or the Pacific . . . their number one source of truck transport was the GMC "six-by-six." And whatever their branch of the Army . . . ground or air forces, combat or supply . . . GMC "Army Workhorse" power proved its ability on the toughest jobs.

Civilian GMCs benefit by the same manufacturing facilities, incorporate the same all-truck construction and feature engines of the same basic design as their military brothers . . . nearly 600,000 strong. Offered in a wide range of models, chassis types and sizes, ½ to 20 tons, new GMC trucks provide war-proved performance for all kinds of peacetime hauling.

GMC "ARMY WORKHORSE" POWER

GMC TRUCKS

THE TRUCK OF VALUE

GASOLINE • DIESEL

Traffic accidents have increased at an alarming rate since the war. Careless driving, jaywalking and neglect of needed repairs are mainly responsible. Do your part to prevent accidents by obeying all traffic laws . . . by driving safely and walking carefully . . . by having your car or truck inspected regularly, repaired promptly and properly.

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AMERICAN DEEP WELL TURBINES

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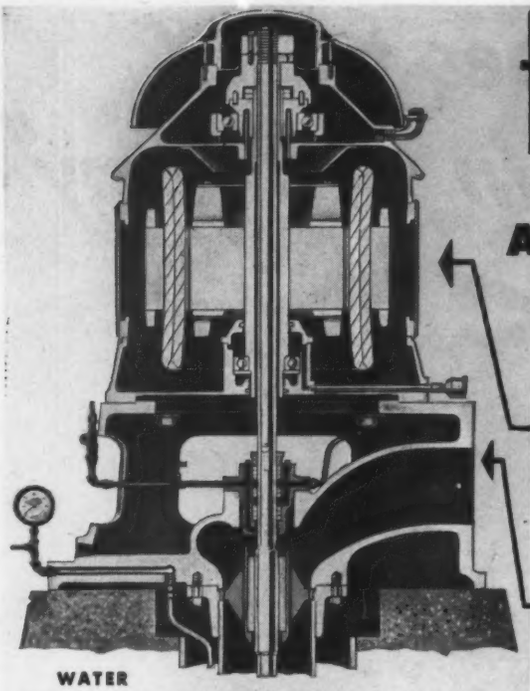
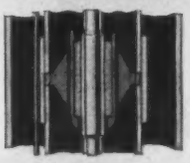
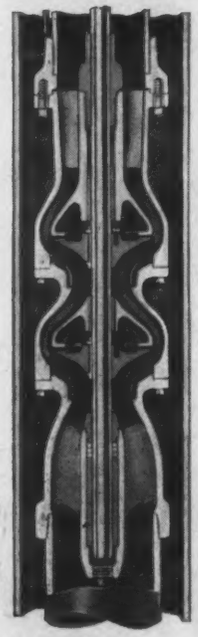
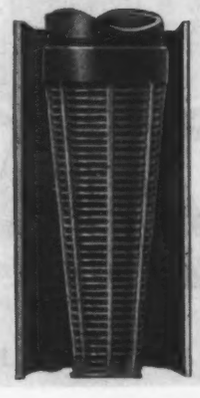


WATER LUBRICATION





No on-the-job column changes necessary



MOTOR—Weatherproof, enclosed type keeps moisture and dirt out of working parts of motor. Hollow shaft design simplifies installation and facilitates adjustment of pump rotating element at top of motor. These turbines are also available for engine or dual drive with right angle gear unit.

DISCHARGE HEAD—Deep bronze packing box, grease sealed, with bronze seal rings and gland, and connections for vent to atmosphere and prelubrication line . . . designed for high pressure with minimum leakage. The top line shaft bearing, actually an *additional* head shaft bearing, is located *at the top* of the column, thereby eliminating whipping through packing box.

COLUMN—Full weight steel column pipe in standard 10′ lengths. Straight thread couplings for sizes up to 7″. Flanged construction for sizes larger than 7″. Bronze bearing housings and guides at each column pipe joint. Water lubricated, fluted rubber bearings at non-corrosive wearing surfaces of shaft.

BOWL ASSEMBLY—Flanged upper bearing, provided with two bearings, cast integral, each bearing having a renewable bronze bushing. Flanged bowls, with uniform and smooth water passages and renewable bronze wearing rings. Shaft steady bearings cast integral, provided with renewable bronze bushings. Flanged lower bearing, provided with renewable bronze bearing bushing and wearing ring, properly lubricated and sealed before shipment, requiring no further attention in the field.

Bronze enclosed impellers have uniform, hand finished water passages. Given a final machining operation after assembly on shaft to assure correct running clearances between rotating and stationary elements, and rotative balance. Stainless steel pump shaft with positive stainless steel locking device to firmly position each impeller to shaft.

SUCTION PIPE—Full weight steel pipe which screws on to lower bearing. One ten foot length generally recommended.

STRAINER—Sturdy, galvanized, taper-type, with threaded coupling for suction pipe. Generally recommended to protect bowl assembly.

Also...Split Case Booster Pumps in a wide range of capacities

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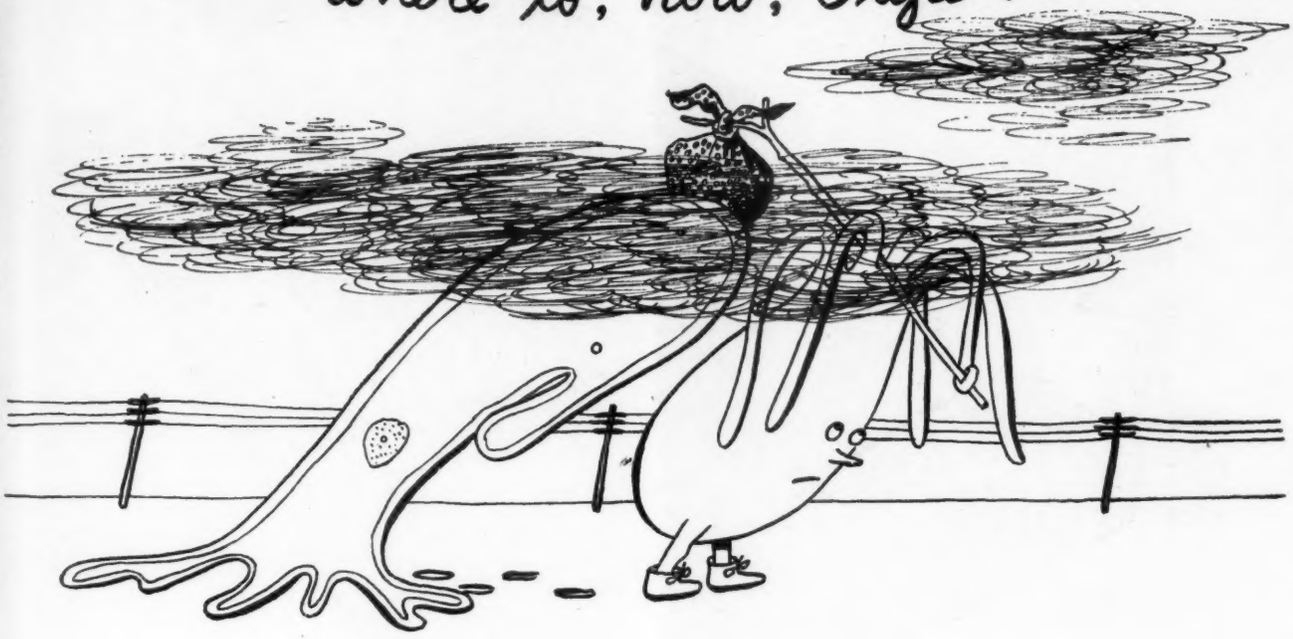
"where to, now, Orgie?"



they're using **PITTCHLOR*** almost every place"

Packed in readily identified red, white and blue 5 lb. resealable cans (9 per case), 3-¾ lb. cans (12 per case) and 100 lb. drums.

It's a sad day for chlorine-susceptible microorganisms when Pittchlor makes its appearance—for its **70%** available chlorine spells sure death for them.

Easy to use, Pittchlor is a high-test calcium hypochlorite which is highly effective in the chlorination of water . . . in the treatment of sewage . . . and for many other disinfection, deodorant and general sanitation applications where such public protection is essential.

Stocked by leading jobbers—write for literature.

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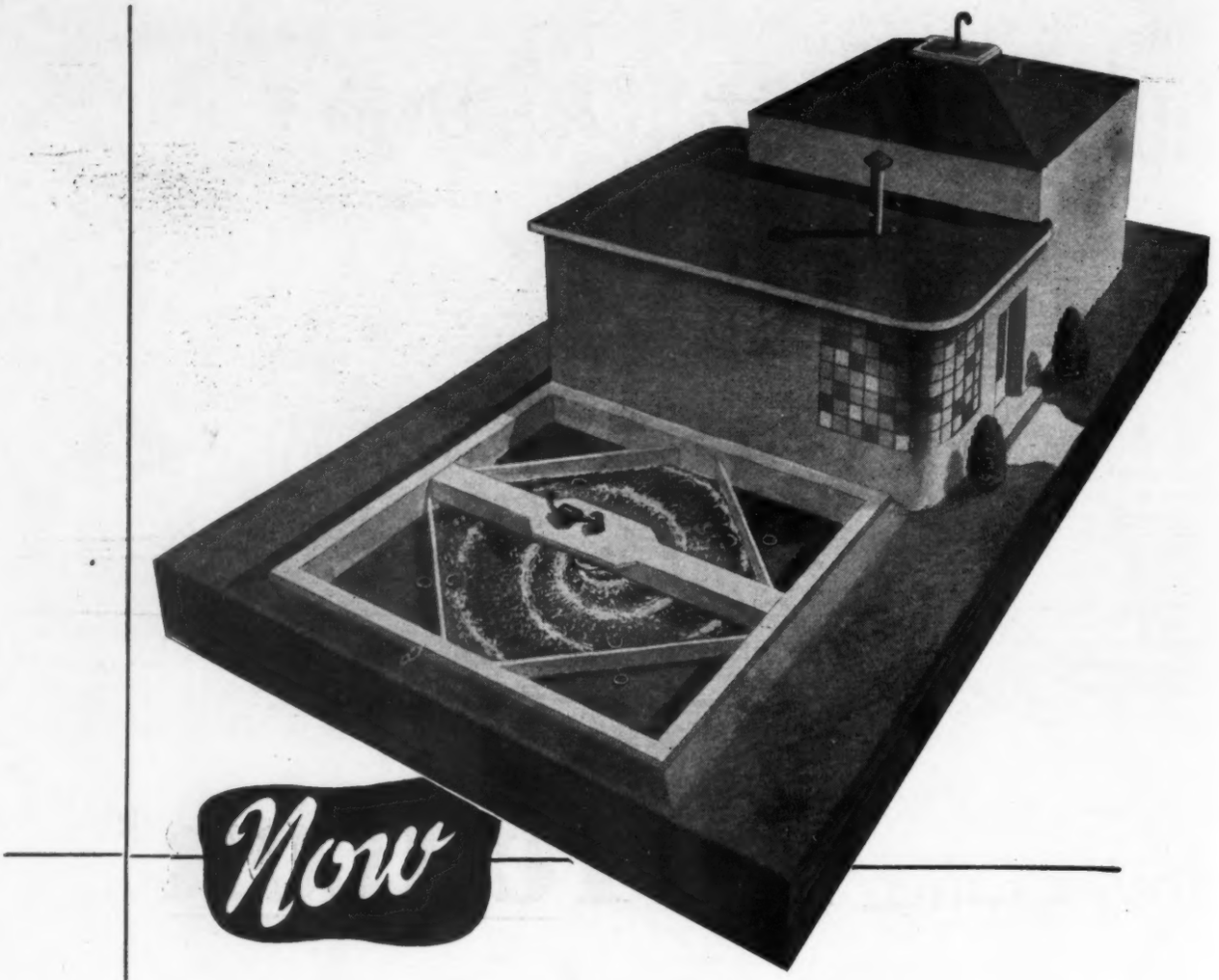

. . . a plant within your budget

Have you had the unhappy experience of getting bids on the sewage treatment plant you want, only to find that it will cost far more than your budget?

There's a simple, practical answer—this Yeomans "Aerifier" Package plant, ideal for small communities up to 3000 persons, and for isolated institutions and industrial plants. You can build it within your budget. It costs little to operate. ***And you can get it quickly.***

In a single compact concrete unit of minimum dimensions you get aeration and final sedimentation—a crystal clear effluent at exceptionally low over-all plant cost. Operation is simplified to a daily routine check. All units are open for visual inspection—clean, odorless.

Installation includes final adjustments, initial factory operation, thorough training of operators and Yeomans engineering counsel.

A complete recommendation with construction cost estimates and application engineering will be sent promptly on request.

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PUBLIC WORKS MAGAZINE . . . November, 1946

VOL. 77. NO. 11

The sewage treatment plant at Camp Myles Standish, Mass.

Sampling at Sewage Plants

Comparison of 8, 12, 16 and 24-hour sampling period results; catch sample accuracy; effect of sampling without regard to rate of flow.

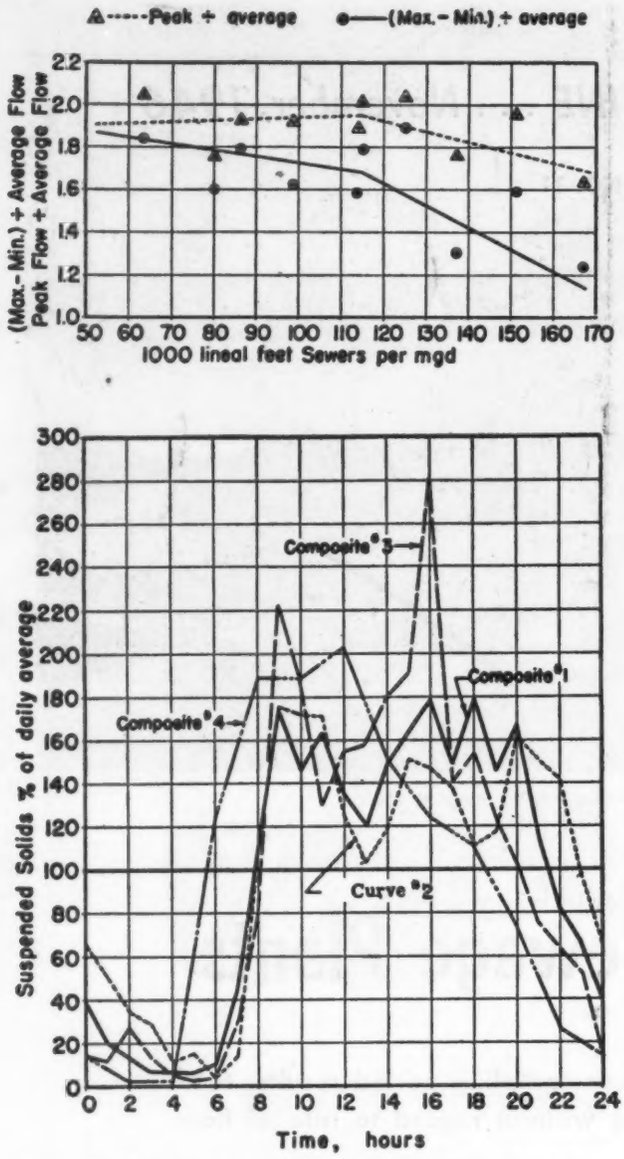
THE taking of samples at sewage treatment plants has not received the consideration it should have. It is fully as important as the testing of the samples; for if the sample does not really represent the liquid it is supposed to, then a perfectly correct determination of its BOD and SS is equally misleading. Efforts to increase the precision of BOD determinations and reduce the laboratory error below 10% are of little value if the sample itself fails by 50%, 100% or even 200% (as it may well do) to be a true representative of the fluid from which it is taken.

This was recognized by the Subcommittee on Sewage Treatment of the Committee on Sanitary Engineering, National Research Council, when it made its study of "Sewage Treatment at Military Installations," published in the September issue of *Sewage Works Journal*. In selecting, from the hundreds of plants, those of which it made careful studies and analyses, it included "only those plants with sampling periods greater than eight hours, and in which composites were formed in proportion to flow." Three factors in the sampling procedure were considered—frequency of sampling (this was hourly in every case selected); period during which sampling was continued (8, 12 or 24 hr.); and whether or not the composite for the day was made up of samples proportional in amount to the flow of sewage at the time they were taken.

As to the first, catch samples can be made to prove almost anything. If one be taken of the raw sewage between 1 and 6 A.M., the plant effluent might be found to be at least 10 times as strong. If taken during the hour of maximum strength, remarkably high efficiency of the plant might be indicated, even though the actual efficiency is poor. This would seem to be self-evident. As an illustration of the magnitude of error possible, at one camp the B.O.D. of the raw sewage varied from a minimum of 5% of the daily average in the early morning to a maximum of 194%.

In regard to the duration of the period during which hourly (or more frequent) samples are taken, the report on military installations gives the following table averaging results from 17 plants:

Sampling Period	*Duration (hr)*	*Percent of 24-hr. average weight of BOD*
8 AM to 4 PM	8	144
8 AM to 8 PM	12	140
8 AM to 12 PM	16	135
8 AM to 8 AM	24	100



Upper chart: **Relation between length of sewers, excluding house connections, and plant flow.** ***Lower chart,*** **typical hourly variations in pounds of suspended solids for various camps.**

This shows that "Evaluation of the total daily load of BOD (pounds) in raw sewage based upon a composite sample formed of hourly increments between 8 AM and 4 PM would be too high by a factor of 44%.

"The foregoing table pertains to results when the composite sample is formed by hourly increments, the volumes of which are proportioned in accordance with rate of flow. In some plants (not included on the survey list) it was the practice to sample with hourly increments of constant volume without regard to flow. This procedure, while simple, does of course entail some error." Tests to determine what this error would be were made at 18 plants. These BOD (ppm), 24 hr. averages, by equal portions were found to be less than those proportional to flow by an average of 11.1%, being as high as 17.3% at one plant. "Such an undervaluation is a consequence of including a disproportionately large amount of weak night sewage that dilutes the composite too much. . . . With samples composited in proportion to flow, 8-hr. sampling in small plants was found to introduce an appreciably greater error than was noted for a corresponding sampling period in large plants."

"The foregoing discussion pertains to influence of sampling periods upon evaluation of BOD of *raw* sewage. Insufficient data were available to make a corresponding analysis for the other usual sampling points, such as final effluent. Data reported by Caster and Hamilton, based upon tests at Fort Knox, are indicative of the influence of sampling period upon evaluation of plant performance. Results in ppm are as follows:

Sampling Period	*Av. Flow mgd*	*Raw Sewage BOD*	*Raw Sewage SS*	*Plant Effluent BOD*	*Plant Effluent SS*
8 AM to 4 PM	4.71	378	376	31	42
8 AM to 12 PM	4.81	334	337	38	44
8 AM to 8 AM	4.03	268	286	35	46

"The BOD results on raw sewage for the 8 hr. period were 41% higher than for the 24 hr. period; the SS were 32% higher. On final effluent the 8-hr. period BOD results were 12.5% lower than for the 24-hr. period and the SS were 9% lower. It is evident therefore that short sampling periods have the effect of exaggerating plant performance, not only from over-estimation of raw sewage strength but also from under-estimation of final effluent concentration."

There would seem to be no question that hourly sampling, with amount of each sample proportional to the flow, is necessary for securing reasonably reliable information concerning plant loading and efficiency of treatment. In general this is truer for small than for large plants, because of the smoothing-out effect of long flow in the sewers upon both quantity and quality. In small plants, where often there are only one or two operators, and these during day time only, hourly 24-hr. sampling is practicable only by use of automatic samples, and these should be such as will proportion size of sample to flow of sewage.

Another problem, not easy of solution, is obtaining raw sewage samples representative of the flow at the time they are taken. Sewage, especially that comparatively fresh, contains a considerable amount of organic matter in particles so large that inclusion of one in a sample may give too high an estimate of sewage strength, while exclusion of all such particles would result in an underestimate. Also the location of the "take" by the sampler as to depth may entirely exclude grease and other floating matters on the surface, or heavier matters moving chiefly along the bottom of the sewer. A suggested solution of this is a mixer located up-stream from the sampler and operated while samples are being taken, to break up thoroughly any floating particles and surface scum and mix them with the sewage.

Production Measurement in Construction

This pamphlet (by the Ministry of Works, London, 1945, H. M. Stationery Office, 13 pp., 9 tables, 6d) distinguishes measurable work, such as feeding cement and aggregates into a concrete mixer, driving the mixer, or placing the concrete, from non-measurable work, such as moving and setting up the mixer. The number of man-hours spent on non-measurable work includes time spent on waiting for materials, etc. Tables give analyses for various jobs and operations, showing also the proportion of measured work to the total of man-hours. These include a concreting operation, based on 12 different contracts, and runway construction, based on 60 different contracts.—*Road Abstracts.*

Narrow pavement, poor alinement and practically no shoulders.

A Mathematical Rating for Priority of Road Construction

The Highway Planning Survey of the New Mexico State Highway Department has established a method for determining priority of construction of State highways.

By H. S. WILEY

State Manager, New Mexico Highway Planning Survey

Illustrations courtesy of Public Roads Administration

ANY system that establishes a mathematical priority rating for various sections of roads must be based on many assumptions. Such a system cannot possibly consider every condition which might provide a reason for improvement of the road, and it cannot entirely replace competent engineering judgment but it can be useful as a guide to indicate which sections need improvement.

Some of the conditions which should be considered in computing such priority ratings are:

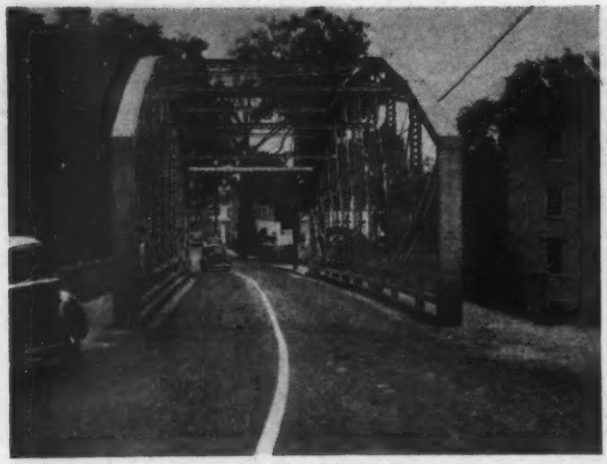
Traffic volume
Types of vehicles
Speeds of vehicles
Number of restricted sight distances
Number of excessive curves
Length of excessive grades
Inadequate width of surfacing
Inadequate width of shoulders
Inadequate strength of bridges
Inadequate width of bridges
Inadequate vertical clearance of bridges
Inadequate number of bridges
Excessively steep side slopes on fills
Inadequate base for the traffic load
Inadequate type of surfacing
Indirect alignment
High maintenance costs
Frequency of accidents

The report on "Future Highway Requirements of New Mexico—1940" establishes desirable standards of construction for various traffic volumes. These standards are used as a basis for computing the inadequacy of present facilities. It is to be noted that these standards vary with traffic volume and it might happen that because of this, a short section in the center of a long section of road would require a lower standard of construction. In this case the short section should be built to the same standard as the remainder of the road, and priority of construction should be so computed.

The following is a discussion of a mathematical computation and rating for each of the conditions which should be considered:

Traffic Volumes.—The final rating of two sections of road should be in direct proportion to traffic volume if all other conditions are equal. Therefore traffic volume should be used as a multiplying factor. As the estimated percentage increase in traffic is not the same on all roads, and as the standards of construction for roads to be constructed should be adequate for 1960 traffic, estimated 1960 traffic volumes should be used. For practical use in a formula, traffic volumes should be divided by 100.

Types of Vehicles.—The distribution of vehicles by



A narrow bridge is a traffic bottleneck, and there are thousands of them.

type does not vary greatly enough to consider it on New Mexico highways.

Speed of Vehicles.—The desirable standards of construction are partly based on vehicle speeds, and so it is not considered necessary to add an additional factor for this.

Number of Restricted Sight Distances.—Other conditions being equal, the rating of roads should be in direct proportion to the number of restricted sight distances per mile; however, many roads have been constructed in the last several years with sight distances on vertical curves of only 633 feet and it is important that older projects with shorter sight distances receive priority for construction. Therefore, sight distances under 500 feet long should receive twice the weight of sight distances 500 to 1,000 feet long, when the standards require sight distance longer than 500 feet. Data available includes only sight distances of 1,000 feet or less so sight distances between 1,000 and 1,200 feet will not be included although the standard of construction for two lane bituminous highways requires the minimum sight distance to be 1,200 feet.

Roads on which the traffic volume requires the construction of four lanes do not require as long sight distances, and in many such cases the present road could be used as two of the required four lanes, so sight distances between 600 and 1,000 feet long will not be considered when four lanes are required.

Number of Excessive Curves.—It is considered that curves sharper than 6 degrees should have the same weight as restricted sight distances less than 500 feet long and curves 3 degrees to 6 degrees should have the same weight as sight distances from 500 to 1,000 feet long.

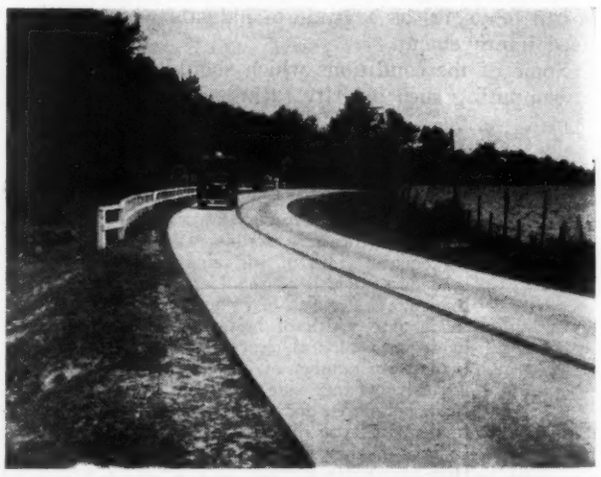
Excessive Grades.—Standards for excessive grades are also based on traffic volumes. The average length of these grades per mile is the correct basis for comparison between sections of roads. The data available is the total length of excessive grades measured P.I. to P.I. Actually, the net length of excessive grade is less than this total because of vertical curves. It is assumed that an excessive grade 1,500 feet long is of equal importance to a restricted sight distance 500 to 1,000 feet long.

Inadequate Width of Surfacing.—Inadequate width of surfacing will normally vary from 0 feet to 6 feet for a two lane highway. It is assumed that a road surface which is 2 feet narrower than required should have equal importance with a road of adequate surface width which has one restricted sight distance 500 feet to 1,000 feet long per mile, other conditions being equal. The inadequate width of surfacing in feet divided by two should furnish adequate weight for this condition on roads which now have a sufficient number of lanes. On roads on which additional lanes are required the factor of three should be used. This is equal to the worst condition which might be found on a two lane surfaced road.

Inadequate Width of Shoulders.—The majority of New Mexico highways are narrower than the required standard. This item is considered to be not as important per foot as inadequate width of surfacing. Therefore, for highways with an adequate number of lanes the inadequate width in feet shoulder to shoulder should be divided by eight and a factor of one should be used when the number of lanes is inadequate.

Inadequate Strength of Bridges.—There are few bridges in the State which do not normally carry maximum legal loads, although many bridges are not designed for standard H-15 loading or theoretically will not carry such loads. All such need strengthening or rebuilding, and as they limit the value of a road this item is given a value of four for each section of road on which such bridges exist, regardless of the number of inadequate bridges.

Inadequate Width of Bridges.—There are few bridges on the main highways of the State which will not carry two lanes of traffic, although there are many which are narrower than four feet wider than the surface width, which is considered to be the minimum required width. Many bridges in recent years have

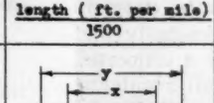


Curve too sharp and inadequate sight distance.

been built only two feet wider than the required surface width and it is not believed such should be given a value in a priority rating. Each bridge narrower than two feet wider than the required surface width is a "bottle-neck" and considered to be of equal importance with a restricted sight distance 500 to 1,000 feet long. Therefore, the number per mile of bridges which are narrower than two feet wider than the required surface width of two lanes only is the value to be used.

Inadequate Number of Bridges.—Many roads in New Mexico still contain spillways where bridges or culverts are needed. The majority of these seldom delay traffic and such are considered to have equal importance with a restricted sight distance 500 to 1,000 feet long. This item is given a numerical value of two for each section of road on which there are spillways where traffic is often delayed by flowing water.

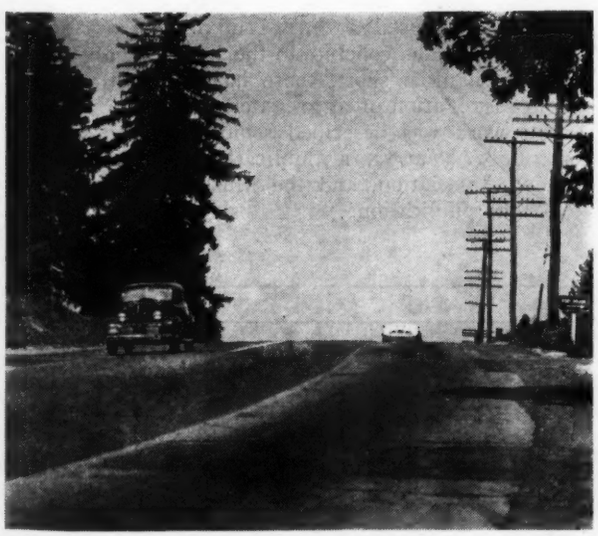
Inadequate Vertical Clearance.—There are no known points on the Federal Aid System in New Mexico where vertical clearance is less than the legal limit. Therefore, this item will not be considered in computing priorities.

ITEM	UNIT OR DESCRIPTION	TRAFFIC VOLUME GROUPS				
		50 to 200	200 to 500	500 to 1000	1000 to 2000	over 2000
Restricted Sight Distances	No. per mile each less than 500' each 500' to 1000'	1 -	2 1	2 1	2 1	2 1
Excessive Curves	No. per mile each over 10° each over 6° each 4° to 6° each 3° to 6°	1 - - -	- 1 - -	- 2 1 -	- 2 - 1	- 2 - 1
Excessive Grades	length (ft. per mile) / 1500	over 8%	over 6%	over 6%	over 5%	over 5%
Inadequate Surface Width	 (18' - x)/2	(20' - x)/2	(22' - x)/2	(22' - x)/2	3 for 2-lane road 0 for 4-lane road	
Inadequate Shoulder Width	(26' - y)/8	(32' - y)/8	(42' - y)/8	(42' - y)/8	1 for 2-lane road 0 for 4-lane road	
Narrow Bridges	Per bridge per mile	less than 20' wide	less than 22' wide	less than 24' wide	less than 24' wide	less than 24' wide
Inadequate Surfacing	Surface in use Earth Gravel Low type bituminous	8 - -	16 8 -	18 10 2	18 10 2	18 10 2
Bridges less than H - 15	4 for each section of road					
Inadequate Base	inches of additional base needed / 2.5 (does not apply to earth roads)					

Values for determining priority of road construction.

Excessively Steep Side Slopes on Fills.—This condition is certainly hazardous, but essentially it exists only on old projects which are too narrow in shoulder width. It is not believed necessary to add an additional factor for this.

Inadequate Base.—One of the main causes of bituminous surface failures is inadequate base. This is one of the most important items of highway inadequacy in New Mexico and it is one of the main reasons for high maintenance costs and hazardous road surface conditions. Inadequacy can be expressed as inches of additional thickness required, which will normally vary from 0 to 20 inches. It is believed that other conditions being equal a road needing 20 inches of additional base should have the same importance as eight restricted sight conditions 500 to 1,000 feet long per mile, therefore, the inadequate thickness of base in inches should be divided by 2.5 to give this item proper importance. It is to be noted that restricted sight conditions, inadequate curves and excessive grades usually occur in pairs, therefore, inadequate base should be given a high comparative value.



Inadequate sight distance.

Inadequate Type of Surfacing.—Standards of surfacing for various traffic volumes have been established. This item carries great importance if the road surface type is not adequate. It is considered that a gravel road which should have an oil surfacing should have the same weight as an oiled road which needs 20 inches of base, other conditions being equal, so the following numerical values are given to inadequate surface type conditions:

Existing	*Required Type*	*Numerical Value*
Earth	Gravel	8
Gravel	Low type bituminous	8
Low type bituminous	High type bituminous	2

If the required type is more than one type better than the existing type, the numerical value should be an addition of the values shown above to arrive at the proper type. This item will not be included if the present type of surfacing is earth.

Indirect Alignment.—Other conditions being equal, the road with the most indirect alignment should receive priority in construction, but this problem is so thoroughly involved with the question of economics of location that every such condition requires individual solution and it is not possible to assign a value to it for comparison between roads.

High Maintenance Costs.—There are many reasons for high maintenance costs. Sometimes they are caused by conditions inherent to the locality, and often they are caused by the inadequate conditions previously discussed. For example, high maintenance costs on bituminous surfaces are to a large extent caused by

inadequate bases. As reprocessing should be included in maintenance costs it would be necessary to average costs for a period of several years, and as this is not possible on many recently built projects, it is difficult to arrive at figures which would adequately reflect the difference between projects. For these reasons this item is not included in the ratings.

Frequency of Accidents.—Many accidents cannot be charged to faults in the road and in many cases it cannot be determined whether or not the road was a contributing cause of the accident. Accidents vary in intensity, from very minor ones to exceptionally bad ones. Only in the last couple of years has a concerted attempt been made to obtain records on all accidents. The number of accidents of record is not sufficient to furnish a consistent enough pattern to reflect differences between all sections of road. The sections on which there have been several accidents have acquired a bad reputation and so it would appear to be best to leave this item to engineering judgment.

An Evaluation Formula and Its Use

Combining the above in a formula the following is derived:

Rating=T (A+B+C+D+E+F+G+H+I+J), where

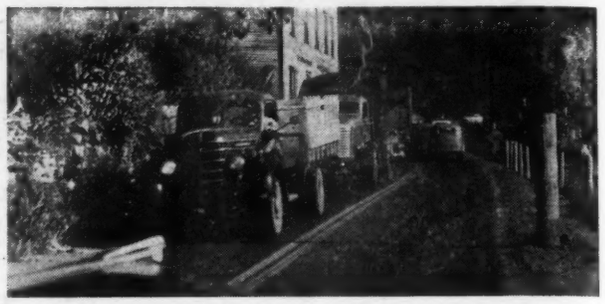
T = Average 24-hour traffic volume in 1960 ÷ 100
A = Value of restricted sight distances
B = Value of excessive curves
C = Length of excessive grades per mile in feet ÷ 1500
D = Value of inadequate surface width
E = Value of inadequate shoulder width in feet
F = Value of bridges narrower than required
G = Numerical value of inadequate surface type
H = Value of bridges of less than H-15 design rating
I = Inches of additional base needed ÷ 2.5
J = Value of bridges needed and not in place

The table herewith indicates the values to be used in this formula.

For sections of road less than one mile long, the actual value of inadequate conditions will be used rather than the value per mile.

The section of road with the highest numerical rating would be indicated as the section which should be first improved. A tabulation showing these ratings should also show the pertinent data on which they were based. A study of these data would indicate the improvement needed, and such a review might indicate that if only one item was corrected the rating would be lowered to such an extent that the priority would be so far below other sections of road that further improvement would not be warranted for many years. For example, structures might be so bad as to furnish a high priority to a road section, and if these were improved separately the priority would be greatly lowered.

Acknowledgement.—This report was prepared under the direction of A. R. Abelard, formerly State Manager of the New Mexico Highway Planning Survey, with the cooperation of the Public Roads Administration.



Narrow pavement, poles too close, sharp curve and inadequate sight distance.

Definition of Artesian Well

"Artesian Well" has become a term loosely applied to wells of more than ordinary depth but strictly speaking, an artesian well is a self-flowing well. The United States Geological Survey restricts the term to a well in which water rises under its own pressure above the point at which it was first encountered, even though it does not flow out at the surface.

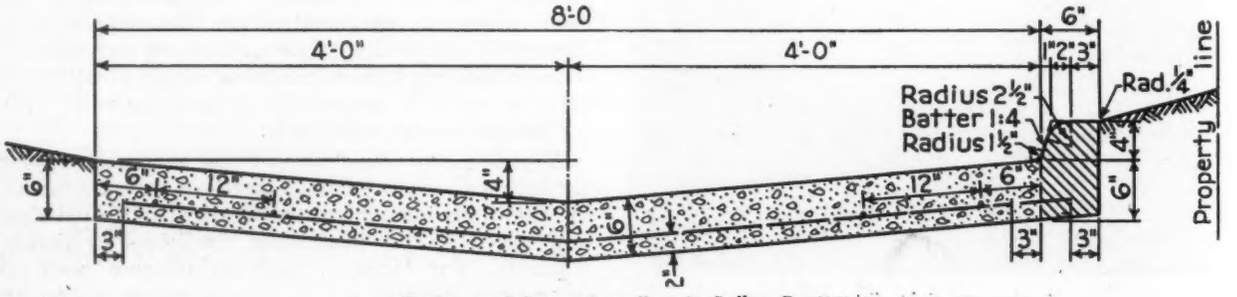
By any definition though, the largest artesian well in the world is located in the Pecos Valley, near Roswell, New Mexico—the rate of flow is 9100 gallons of water per minute.—*Pittsburgh Empire Water Journal.*

Dallas Paves Alleys With Concrete

A year ago, Dallas, Tex., started a program of alley paving. Under this program, approximately 45% of the cost is paid for by the property owners and 55% by the city. It is necessary for interested property owners to initiate each project. If they obtain the consent of a majority of the property owners along the section of the alley to be paved, the city will proceed with the work and will levy assessments against the property for the work. The city makes the surveys, prepares the plans, awards the contract and pays the contractor. It then charges each property owner his share of the work. This may be paid for in a lump sum or in 6 to 12 monthly installments.

A typical cross-section is shown herewith, the integral curb being used only where the alley is appreciably lower than the adjacent property. The contractor has used a central mixing plant for the work, hauling the concrete to the job in dump trucks; since the haul is short, there has been no difficulty due to segregation of aggregates.

This work was described somewhat more fully in *Concrete Highways,* a publication of the Portland Cement Association, and the illustration herewith is from that publication.



Section used for paving alleys in Dallas, Texas.

An Emergency Water Treatment Plant for Dickinson, N. D.

Details of a plant built under immediate post-war conditions, in which substitutes were used freely in order to expedite construction.

By ROLAND BOEHLKE
Waterworks Superintendent

RATIONING of water has been necessary in Dickinson, N. D., for the past few years, especially in the summer months when the demand was heavy. The development of an emergency supply was decided on a year ago and a new plant with a capacity of 500,000 gallons per day was built in two months. The plant was designed by Lium and Burdick and built by the Haggart Construction Co. Non-critical materials were largely used; the cost was $29,000. Water is taken from the Heart River, where a small dam was built some years ago by WPA labor. The plant is described in the *Official Bulletin* of the North Dakota Water and Sewage Works Conference as follows:

The raw water flows through a 10-inch tile, which is about 18 inches below the surface of the stream, into a well 6 ft. from the river's edge. This well is cased with 12 ft. of 48-inch I.D. concrete pipe and has a clay bottom. A 7½ HP, 350 g.p.m. Fairbanks-Morse turbine pump elevates the water 35 ft. through 6-inch cast iron pipe to the plant proper, which is situated on a rise 125 ft. from the river; here it is discharged into a concrete mixing chamber 6 ft. in diameter and 16 ft. in depth. The water in this chamber is agitated by the incoming raw water discharging through a 2¾ inch orifice 2½ ft. below the surface. The flocculation chamber is a counterpart of the mixing chamber adjacent to it and connected at the bottom by a 6-inch pipe tangent to both, giving the water in the flocculation chamber a slower circular motion. All of the chemicals for treating are introduced at the mixing chamber: chlorine by a W & T visible vacuum chlorinator of 50-lb. capacity; lime and alum by International dry feeders; and carbon in a water suspension by a feeder made of a cellar-drainer type pump mounted in a 55-gallon oil drum. The lime and alum solutions are carried by wood troughs.

From the flocculation chamber, the water flows through a 12-inch pipe to a rolled earth sedimentation basin. This is 65 ft. by 124 ft. with sides sloping 3 on 1. A wooden baffle of 1" x 6" boards, spaced ¼" apart, divides the basin and a similar baffle 6 feet long, in front of the inlet pipe, distributes the incoming flow. The settled water flows over a weir and through a 12-inch pipe to the filters, which are about 50 ft. distant.

There are three filters, each with a surface area of 60 sq. ft.; 6-inch hand operated valves are used to control filtering to the clear well, filtering to waste, etc. The wash water valves are 8-inch; the wash water is drawn from the discharge side of the pump discharging to the city mains.

The clear well is an underground concrete cube measuring 12 ft. on the inside. The finished water is pumped to the city mains by a 25 HP Fairbanks-Morse turbine pump, designed to pump 350 g.p.m. against a 170 ft. head.

The entire plant is in the open except for the pumps, feeder, chlorinator and chemical storage. These are housed in frame structures covered with Nu-Wood sheathing, making it a strictly non-winter setup, although by warming the chlorinator we were able to operate through October last year.

A few changes were made last fall and this spring to facilitate operation: a 1¼" mesh wire screen was placed ahead of the tile taking water from the reservoir. This is cleaned of floating debris daily; the raw water well was bisected by a removable screen of half-inch mesh, the influent being on one side and the pump on the other. These screens have proven entirely satisfactory. A counter-balanced check valve was placed at the discharge of the raw water pump, making it possible to back-wash the pump screen by raising the check gate. The orifice in the raw water line was decreased in size from 3 in. to 2¾ in. to balance the flow between the raw and clear water pumps. Prior to this change the clear well had a habit of overflowing. Ammoniation was tried last summer and early this spring with passable results as long as the pH of the raw water remained below 8.2. As the pH increased we found it necessary to eliminate the ammonia and increase the chlorine feed from 6 p.p.m to as high as 15 p.p.m. During daylight hours and warm sunny days a large amount of chlorine is dissipated in the settling basin, but we cannot practice post-chlorination alone because of the short retention period in the clear well. We are now using both pré- and post-chloriation in order to produce a safe water and to maintain a more uniform residual in the finished water. Bacteriological examinations have shown that during daylight hours the free chlorine residual in the clear well must be kept at .75 to 1.0 p.p.m. and at night at .5 p.p.m.

During construction, a 6-in. line with ½-in. holes spaced every 4 in. was laid on the bottom of the settling basin for sludge draw-off. We found it necessary to enlarge alternate holes to ⅞ in. to facilitate sludge removal when the basin was being emptied. The quick acting sludge draw-off valve is opened every other day and the basin is drained completely once a month. This cleaning is a laborious, messy job in an unlined basin.

The dry feeders in use are some which were worn out and discarded by the Bismarck plant and were installed here because of the urgency of getting the plant into operation and to keep down the cost. These feeders are being replaced by the two new Syntron gravimetric feeders—thank goodness. Tentative plans have been made for lining the settling basin with concrete and housing the filters and pipe gallery this fall.

Morris N. Lipp,
City Engineer

How Miami Beach Meets Its Special Sewerage Problems

A popular resort area, with an elevation of 5 ft. above sea level, has developed special methods of handling its sanitary and storm sewage.

By DON FRANK

THIS winter, between November and April, some 600,000 persons will visit the City of Miami Beach, Florida, an eight square-mile island with an average artificial elevation of five feet above sea level and an annual precipitation of sixty inches. The low, flat topography, destructive gases generated by a soil more than half composed of decayed vegetation, rains of high intensity, and a population fluctuating as much as 65,000 in a month have resulted in sanitary and storm sewer problems which have challenged the ingenuity of the City Engineering Department.

In many instances, the City Engineer, Morris N. Lipp, who has headed the department since 1933, has been forced to depart from orthodox practice with results that have been both satisfactory and informative. Of particular interest to city engineers everywhere have been his necessary use of shallow construction methods and a system of independently-operated pumping stations served by a common force-main.

Of all the problems which have faced the City Engineer and his staff, the foremost has been the unusually rapid growth of this resort island. Just 30 years ago, Miami Beach was an almost uninhabited wilderness of sand dunes and mangrove swamps. Today, it is a city of 35,000 persons which, six months of each year, becomes a metropolis of 90,000 temporary residents.

Handling Sanitary Sewage

The first sewer system in the rapidly expanding city was laid in 1922. This system, located at the southerly end of the island, could discharge only during outgoing tides. The pumping station was at 11th Street. The first of many expansions occurred in 1926 when a station was constructed at 28th Street to provide service as far north as 47th Street; less than five years later, further expansion was necessary which included 47th Street to 63rd Street, with a tie into the 28th Street Station. By 1937, the storage tanks which held sewage during incoming tides at the various pumping stations were overtaxed. The still-developing city was also faced with the problem of providing services to new sections which could not be economically served by the old system, and of anticipating loads which would result when areas, then beyond the city limits, would have to be served.

The solution was the construction of a 36″ cast iron outfall line discharging screened sewage into the Atlantic Ocean in forty feet of water, 7,000 feet offshore at 74th Street. This disposal system was put into operation December 17, 1937, and now serves the city's seven pumping stations which are connected to the outfall by a common force-main.

Two problems, in particular, confronted the Engineering Department and Malcolm Pirnie, their consulting engineer, in the construction of the ocean outfall: to make the line secure against hurricane wave damage and to prevent beach contamination. The first was met by sinking the entire pipe line in a rock trench with a minimum cover of two feet, and supplementing this cover with concrete cradles and with concrete dams across the trench at intervals of 250 feet. Beach pollution was prevented by locating the point of discharge close to the westerly edge of the Gulf Stream where sewage would be carried away by natural currents. The effectiveness of this location is demonstrated by the fact that no contamination has ever been discovered in the water analysis made monthly by the Public Health Officer of Dade County.

Storm Drainage

Of an importance equal to sewage disposal has been the handling of storm waters. The figure of 60-inch annual precipitation does not give the entire picture, as rain frequently falls with unusual intensity. In the early days of the city, it was economically unfeasible to drain the streets rapidly; as the city grew, however, many of the drainage structures were supplemented. An example is an intersection 4,000 feet from the bay and only 3.5 feet above sea level which was originally drained by a line averaging 18″ in diameter. Water in this intersection would remain from 24 to 48 hours after periods of heavy rainfall. A box culvert of 30 square feet inside area was constructed which now carries off the water as fast as it falls.

Drainage is into Biscayne Bay and the several inland waterways. No water is drained directly into the Atlantic Ocean. Where possible, storm sewer lines are interconnected so that one system can offer relief to another. Although some study had been given to the installation of pumps for the larger storm sewer systems, the City Engineer discarded the idea in favor of large box culverts which could be economically constructed and would provide more positive action.

The flat topography has required that the hydraulic gradient in the storm water drainage systems be established by the difference in elevation between curb grade and high water at the outlets. In applying

this principle, the crown of the drainage sewer is kept below the hydraulic line. Regardless of the slope and the depth to which the sewer is constructed, the gradient in the system is not changed by any factor except the height of the tides—approximately two feet within the Bay. Thus, in practical application of this principle, storm sewers are constructed at economical depths and radical grade changes can be made to avoid other underground utilities.

In some residential sections where drainage areas are small and the run-off is low, the drainage structures are pipe lines. In certain business districts where drainage areas are large and the run-off high, box culverts have been constructed.

Sewer gases destructive to certain classes of materials have been discovered by the City Engineer to be caused principally by the old mangrove swamps over which fill has been pumped. Deterioration, he has found, has generally been above low water on the exposed sections of structures. Under mangrove conditions, and in storm sewers where it is necessary to use materials subject to deterioration, he has directed construction so that these will always be submerged.

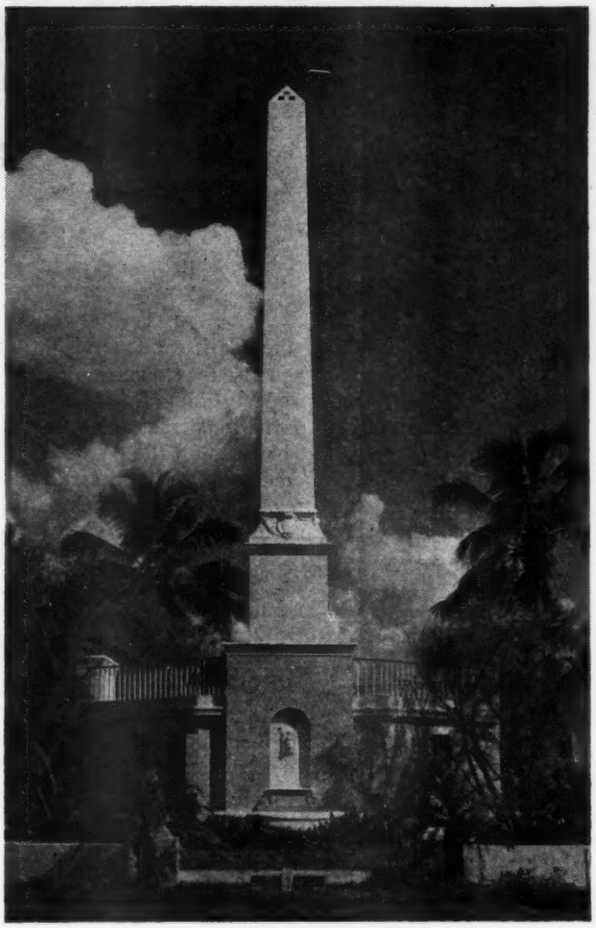
The necessarily shallow construction and unstable soil conditions have resulted in most pipe lines being laid in concrete cradles. Concrete is placed under and along the side of the pipe midway between the spring line and the crown. This procedure has a number of advantages: it strengthens the pipe; diminishes the tendency toward settlement; and reduces infiltration. In many cases, the unstable mangrove material below the pipe is removed and the space backfilled with sand. Cement joints are used in lines with cradles; in other lines bituminous joints are used.

Pumping Sanitary Sewage

Unique in a large city is the use of a common force-main to serve seven independently operating pumping stations handling sanitary sewage. This method was designed to meet the varying requirements of volume and pressure, due to the fluctuating population. Pumps at the larger stations are equipped with variable-speed motors. The force main from the 11th Street to 69th Street stations (where the greatest population is concentrated) is 30″ in diameter; from 69th Street to the 74th Street outfall it is 36″. The system of independently operated pumping stations, rather than lifting from one station to another, is desirable both for its flexibility and for the fact that a breakdown or stoppage in one station will not affect the other stations. Also, it avoids the necessity of providing excessive sewage storage capacity at each station.

Collection lines which must carry peak loads must be laid on extremely flat grades because of the topography, high ground-water table and excessive cost of locating deep sewers in unstable and pervious soil. At one time, the city considered steep lines with a number of lift stations but discarded this method because the failure of one station due to hurricanes or other reasons would shut down the entire system. In low-lying Miami Beach, this would back sewage into homes and other buildings. Over-loading or a temporary stoppage in a discharge line would have the same effect. According to the City Engineer, it is possible with the present small number of pumping stations to provide emergency overflows into nearby waterways, an operation that would be impractical with a large number of lift stations.

Stoppages are very rare despite the flatness of sewer grades. The department uses a self-propelled sewer cleaning machine developed by A. E. Kelpsh, Sewer Superintendent. This device consists of a wheeled carriage frame with interchangeable shields to fit sewers of various sizes. It moves with the force of the sewage and is designed to be operated from street level. A sewer cleaning crew functioning about six months of the year and consisting of a foreman and three men is able to keep the entire system in such order that only about five stoppages occur yearly.



One of Miami's sewage pumping stations.

Since the first sewer installation in 1922, Miami Beach has grown with rapidity. In the eight years prior to the war, approximately one hundred million dollars worth of buildings were constructed, and within the limitations of the CPA program, the city is still growing—and the city sewer program is growing with it. Since 1937, expansion has consisted of extension of collection lines into remote areas and construction of two new pumping stations making a total of seven.

A new 30″ cast iron force-main has been built. Pumps and motors of increased pumping capacity, on order for all stations, will be installed in the fall of 1947. The 11th Street Pumping Station, the first built, will have to be enlarged to handle the new equipment; the other stations were designed in anticipation of it.

All pumping stations will be provided with stand-by equipment. It is estimated that at peak load, the combined stations by 1947 will be able to discharge a total of 16,500 gallons a minute as compared with 1945's peak of 10,000 gallons a minute. This figure, in itself, is ample evidence of the progressive methods employed in the Engineering Department of the City of Miami Beach.

Liability Insurance as Related to California Highway Contracts

By KENNETH A. KEYES
Assistant Engineer, California Division of Highways

AS A general policy, the California Division of Highways does not specify that contractors furnish public liability and property damage liability insurance as a prerequisite part of contracts for the construction of highways and bridges on the State Highway System. However, in the construction of railroad grade separation structures, the railroad companies have insisted that, because of the magnitude of the risks involved, they be given adequate protection.

The "save harmless bond" form of protection was used in State highway contracts until 1937, when the Federal Bureau of Public Roads, now the Public Roads Administration, prescribed that on all grade separation projects, financed with Federal funds, the railroad must be protected by standard liability insurance. The regulation established at that time is still in force and in general use throughout the United States.

Three Types of Insurance

This regulation requires that a contractor performing work in connection with railroad grade separation structures be required to furnish the following three types of insurance:

1. Contractors' public liability and property damage insurance covering all accidents occasioned by work under his direct control.
2. Contractors' protective public liability and property damage insurance protecting the contractor from accidents in connection with work being performed for him by subcontractors on the project.
3. Contractors' protective public liability and property damage insurance specifically protecting the railroad company in any accident arising from the construction work.

By far the greater portion of highway-railroad grade separation work is financed with Federal funds; however, as the various railroads insist on protection for all work, insurance similar to that specified under the 1937 Federal Memorandum is also required of contractors on contracts financed with other than Federal funds.

Subcontractor's Insurance

The amounts of insurance that are required are determined by agreement between the State and the railroad for each project. In general, the minimum requirement for public liability insurance is $100,000 per person and $200,000 per accident and for property damage liability the coverage is $25,000 per accident and $50,000 aggregate per job or policy period.

In order to complete the insurance protection, subcontractors, where insurance is specified, are required to carry the direct coverage outlined above.

Because the various insurance companies, in furnishing this protection use adaptations of their standard forms, in which some of the hazards encountered in highway construction are often excluded, it has been necessary to require that certified copies of all insurance policies be submitted for approval with the contract documents. The nonacceptable exclusions include hazards due to blasting, excavating of foundations, the use of automotive equipment and in some cases all damage caused by work on streets and roads.

All policies must carry a certification that the State shall receive a minimum of five days' prior notice, by registered mail, of any cancellation or reduction in the policy. This is a contract requirement where the hazards justify an insurance requirement for construction work.

A number of insurance companies separate the automotive property damage liability from other property damage liability. In these policies the automotive coverage is usually limited to a lesser amount, often $5,000, per accident. The State's agreements will not permit acceptance of a lesser limit per accident and such policies must be revised to meet the contract minimum (usually $25,000 per accident and $50,000 aggregate) before they can be approved.

Processing Problems

The greatest problem is in processing insurance required of subcontractors. These concerns, often performing very minor portions of the work, as working on the completed deck of an overhead crossing or pavement of an undercrossing, find that the minimum requirements apparently exceed the value of the work or apparent hazard involved. The fact is overlooked that the primary reason for the insurance is to provide protection for the railroad, where, because of the number of people that may be involved, the total liability in an accident is greatly increased.

In the postwar construction program now under way, it has frequently been found expedient to combine certain work in connection with grade crossing elimination projects with adjacent roadway construction. On these projects only a small portion of the work usually is on railroad property. However, because of the railroad hazard and in accordance with agreements between the State and the railroads, it is necessary to incorporate insurance requirements in the contracts.

In resume, liability insurance, in general, is specified in State highway construction contracts only to fulfill the State's obligations with another agency, usually a railroad. Insurance must be provided which will give a complete coverage for all risks, and full coverage must be provided throughout the life of the contract. Each subcontractor performing work that might endanger a railroad must also furnish direct insurance coverage. Each policy must certify that the State shall receive prior notice of cancellation or any reduction in coverage. One certified copy of all insurance policies must be approved by the State's attorneys and be placed on file with the contract documents. (Republished from California Highways and Public Works.)

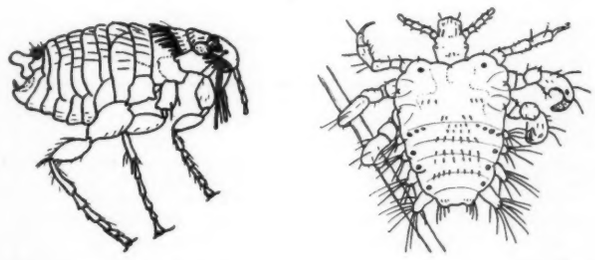
The cockroach, left; fly, center, and mosquito, right.

Municipal Insect Control—an Aid to Health and Comfort

By Captain Robert S. Taggart, Sn.C., and Captain John V. Osmun, Sn.C.
Sanitary Engineer and Entomologist, Second Service Command

THE large scale control measures undertaken in the past few years against both pests and the insect vectors which spread malaria, typhus, the dysenteries, and neurotropic infections have been watched with interest by municipal administrators and public health authorities everywhere. Progressive citizens are considering how these measures may be applied in their home towns. A new interest and impetus has been given to insect control programs by the development of the powerful new insecticide DDT which has proven its value against a wide variety of insects.

One of the important lessons taught by World War II is that the control of pestilential insects is as important as food, water, clothing, or ammunition in waging warfare in areas abounding with these winged, or crawling destroyers of health and vitality. By mastering these pests, our fighting men were able to win victory after victory in jungles and on islands where ignorant, careless men would have perished. These lessons in insect control, learned at heavy cost, will be remembered and should be applied in every community to which veterans from our armed forces are returning. Although the signal success of the Army and Navy in preventing insect-borne disease has been well publicized, it may not be so well known that this success was due in large part to the skilled entomologists and competent engineers who planned and conducted the insect control programs. Many of these men are now available to carry on similar work for industry, governmental agencies, and the American public.



The flea, left, and the louse, are important spreaders of disease.

Among the insects of public health and economic importance which may well be controlled by municipally sponsored action are the common housefly, the mosquito, the louse, the flea, the cockroach and the bedbug. The control of many of these common pests is limited only by the interest, ingenuity, and industry of municipal leaders.

Let us consider each of these insects in some detail:

Flies—One of the most important insects from the standpoint of the spread of disease is the common housefly. This insect has been incriminated in the spread of enteric diseases such as typhoid fever, the dysenteries and diarrheas, and those caused by certain parasitic worms. Flies multiply with great rapidity in the rotting garbage and other debris of municipal dumps. They soil the food in school cafeterias, they endanger the quality of milk and other perishable food, and they are constantly a nuisance. However, an understanding of the fly's habits and knowledge of adequate control measures can practically eliminate this scourge.

Cleanliness, careful waste disposal, and screening have long been established as essential fly control measures. They remain the basic prerequisites of control. The elimination of the open dump by use of a sanitary fill or an incinerator prevents fly breeding by the million. Thorough street cleaning and sanitary disposal of manure and putrescible wastes removes breeding places. Screening of buildings, particularly those places where food is prepared or served, keeps flies from spreading infection by the oral route.

Many insecticides are effective against flies but most promising for municipal use is DDT. DDT does not kill with extreme rapidity, but applied as a 5% solution or emulsion at the rate of one quart per 250 square feet, to screens, walls and resting places frequented by flies, it exerts a residual killing effect that persists for four to six weeks on flies coming in contact with the treated surface. The day has passed when the fly can be considered a necessary companion; the day has come when it is a municipal obligation to eliminate it.

Mosquitoes—In many parts of the world the mos-

quito is man's worst enemy since she is a carrier of malaria, dengue, yellow fever, filariasis, and equine encephalitis. Despite the gratifying progress made, malaria is still a common disabling disease in parts of the United States. This disease requires the concerted efforts of municipal, state and federal authorities for control of its vector, the anopheline mosquito. Pest mosquitoes, too, are often of economic importance since they are nuisances detracting from business and realty values. Mosquito Commissions are often established to cope with this problem.

Since all mosquitoes must have water in which to pass their early stages, the elimination of the water surfaces in which they breed, or the treatment of these surfaces with larvicides during the breeding season, are the well established methods of control. The many kinds and varying locations of water are reflected in the many different species of mosquitoes each of which requires a particular habitat for development; for example, the common house mosquito breeds in roof drains, and in pools and puddles of water along roads, while salt marsh mosquitoes spend their early lives in brackish water. To the untrained eye, these mosquitoes may appear the same, and yet their control is often entirely different. It is because of this variance that it is a necessary entomological procedure to find their breeding spots as a guide for intelligent control measures. Once the survey has been completed, the entomologist and the engineer should cooperate in planning a complete and economically sound control program.

The modern mosquito control plan should include the use of DDT both as a larvicide and as an adulticide. Effective control of larvae is ordinarily established by using a weekly application of one half percent DDT in oil at the rate of five to eight gallons per acre. Spraying the interior of buildings and treating window screens to obtain the residual DDT effect against mosquito adults is a striking new approach to the prevention of mosquito borne disease since the infected insects perish before they can seek out a new victim.

Outdoor spraying of DDT with power equipment, aerosol dispensers, and airplanes is a promising new method of control, but one which should be applied only under expert entomological guidance.

Lice—Teachers in the public schools, welfare workers, and the wardens of penal institutions often find their charges infested with head and pubic lice. Thoroughly dusting the clothing and the infested hairy portions of the body with ten percent DDT in talc will destroy these annoying parasites and will prevent any possibility of disease transmittal by the lice.

Fleas—Occasionally municipal buildings may become infested with fleas, which feed voraciously on human or other hosts. Spraying floors or wall surfaces harboring these insects at the rate of from one to two quarts of five percent DDT in kerosene for each 250 square feet will give complete relief. Dogs infested with these insects may be treated by rubbing a small amount of ten percent DDT dust into their fur. In certain localities, fleas are associated with the spread of endemic typhus or plague. In these instances, flea control should be employed to supplement rodent abatement programs. The U. S. Public Health Service and the U. S. Fish and Wildlife Service should be consulted.

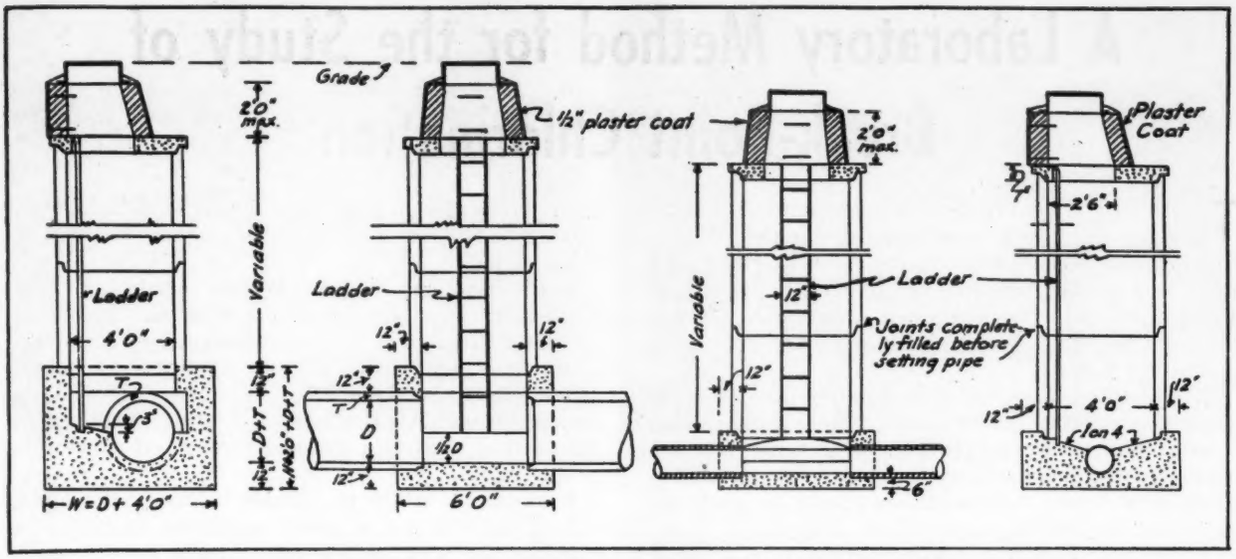
Bedbugs—The warmth loving, socially inclined bedbug is likely to be a permanent guest at municipal lodging houses and jails unless taken firmly in hand. Fortunately, this nocturnal feeder may now be destroyed by spraying mattresses, beds, and adjacent walls with five percent DDT in standard deobase. This treatment has been effective in preventing reinfestations for periods up to a year.

Cockroaches—Because of their hardiness and vigor, their love of warm shelter, and their prolific nature, cockroaches are often a nuisance around cafeterias, hospitals, and lunch counters in municipal buildings. Cleanliness and good housekeeping are necessary in any roach control program. In addition, roach powder, consisting of sodium fluoride and pyrethrum, applied weekly, is useful in destroying these insects. Five percent DDT spray followed several days later by an application of ten percent DDT dust is effective also in keeping roaches under control. Here again, the knowledge of the type of cockroach present determines the type of control to be recommended.

(Continued on page 34)

INSECTS	STRENGTH	FORMS USED	AMOUNTS	AREA TREATED
Flies	5%	Sprays	Cover fly resting place with spray. 1 pint to 120 sq. feet	Screens, edges of ceiling, cracks and crevices, electric light cords, garbage areas, etc.
Mosquitoes	5%	Sprays	Apply thoroughly to places visited by adult mosquitoes 1 pint will cover an area of 120 sq. ft.	Closets, porches, wall surfaces, ceilings, dark corners, underneath beds, tables and other furniture, behind pictures, door and window screens.
Fleas	5% spray 10% dust	Dusts Sprays	1 qt. spray to 250 Sq. Ft. of surface. 1 heaping teaspoon of dust to medium sized dog.	Spray or dust applied to floors and other infested areas. Dog and cat sleeping places, basements. 10% dust applied to dog. Do not use spray on pet animals or apply dust to cats.
Bedbugs	5% spray 10% dust	Sprays Dusts	1/2 cup of 5% spray per bed. 2 oz. 10% dust per bed.	Bedsteads, mattresses, springs, pillows, baseboards, and cracks and crevices.
Cockroaches	10% 5% will kill some species	Dusts Sprays	Varies greatly	Spray or dust all cockroach runs underneath lavatories, tables, behind iceboxes, and refrigerators, infested closets, etc.

Chart for the use of DDT for five common insects.



Left, concrete pipe manhole for sewers over 24" in diameter, with straight runs of pipe or change in direction less than 45°; right, manhole for pipe sewers 8" to 21" diameter.

Concrete Pipe Manholes Used in Large Sewer Construction Program

By J. E. KONKLE

Pre-cast concrete pipe is being utilized for manhole construction in Franklin County, Ohio, where a $1,500,000 sewer installation program is under way. This manhole reduces overall costs, shortens construction time and reduces the need for skilled labor, especially bricklayers, who represent a construction bottleneck. The Franklin County sewerage program was planned and designed by Burgess & Niple and the Jennings-Lawrence Co., consulting engineers of Columbus, O., under the general direction of Grover Clements, Franklin County Sanitary Engineer. The use of a pre-cast concrete pipe manhole was suggested by the Universal Concrete Pipe Co. of Columbus, and developed by cooperation between the pipe manufacturer, the consulting engineers and the County Sanitary Engineering Department.

Installation of a pre-cast concrete pipe manhole is a relatively simple and rapid process, and consists of pouring the concrete base, placing sections of concrete pipe to the desired height for the risers, and positioning the pre-cast concrete lid.

The design for the base of the concrete pipe manhole is similar to the base constructed for most manholes. Nearly every designing engineer has his own ideas as to the hydraulics involved in the design of the base of a manhole. Engineers of the Franklin County project determined that a monolithic type base would be more practical than a pre-cast base section because the sewer line varied from 8" to 24" in size. Also, the size and weight of a pre-cast base section usually involves the use of special equipment for handling.

Installation of the pipe forming the manhole riser is simple and rapid—mortar is placed in the female end of the pipe before the next pipe above is lowered. Almost any desired height can be achieved through the use of a combination of 3' and 4' lengths of concrete pipe. The derrick or winch equipment used on the average sewer construction job is suitable for the installation of the 48" reinforced concrete sewer or culvert pipe which weighs approximately 850 pounds per lineal foot and is delivered to the manhole site in 3' or 4' lengths.

A marked advantage in using concrete pipe manholes is the reduction of infiltration. The tongue and groove concrete pipe used in these manholes forms very tight joints in the manhole as the weight of each section adds a tremendous pressure to each joint.

The pre-cast circular lid used in the Franklin County project is a 7" reinforced concrete slab formed to fit into the female end of the pipe and permit a small mortar grout space.

Two outstanding features of the lid are: (1) the offset opening in the lid makes possible a direct vertical descent to the ladder and (2) it provides for future grade adjustments by acting as the base for the transition section. The lid for a 48" manhole weighs approximately 1,275 pounds and to facilitate handling, two hooks are cast in the top of the lid. The cost of a 48" lid in one area was $15.00; but this will vary with local labor and material costs.

A prefabricated galvanized ladder is hooked over the top of the lid and grouted at the bottom. The length, of course, varies with the depth of the manhole. The ladder has been produced as low as $1.25 per lineal foot. This type of ladder can be fabricated in the average metal shop equipped with welding facilities.

As a final step, the transition section is bricked up to the height desired, which usually is approximately one foot because 3' and 4' lengths of pipe will combine to almost any height desired.

Besides possessing the advantages already enumer-

(Continued on page 34)

A Laboratory Method for the Study of Break-Point Chlorination

TO EVALUATE break-point chlorination possibilities for any given water supply, a series of procedures have been prepared by A. E. Griffin, and published by Wallace & Tiernan Co., as Technical Publication 213. The suggested program to be followed in the study is shown herewith. Details of the procedures follow.

1. *Chlorine Water,* not hypochlorite, must be used. A suitable solution can be obtained from a chlorinator solution hose or by bubbling chlorine through water obtained from the laboratory tap. Due to the instability of chlorine water, fresh solutions should be made up daily and should be standardized immediately prior to the start of each test. It is preferable to use amber bottles for the chlorine water. Standardization is by titration wih N/10 or N/40 sodium thiosulphate, either in accordance with Standard Methods of Water Analysis, 8th Edition, 1936, page 165, or by the method described in the pamphlet mentioned above.

Strength of the chlorine water should be such that the volume of the treated sample will not be increased by more than 5%. Convenient strengths for treating liter portions are as follows:

Dose ppm.	*Strength Cl_2 Solution*
0— 5	100— 200 ppm.
6—10	200— 500
11—20	500—1000

2. *Samples.*—Set up a series of at least ten aliquot portions (500 cc. or more) of the water under test. Use beakers or other glass containers of ample capacity to permit mixing the chlorine with the water. Mixing should be done while the chlorine solution is being added.

3. *Chlorine Application.*—Within certain limits the break-point is a function of the ammonia content of the water. Because of this, a convenient way for determining the approximate chlorine application required to produce a "break-point" is to multiply the NH_3-N content by ten. Applications of chlorine should be so arranged as to cover a reasonable range on either side of this figure.

4. *Contact.*—Allow the sample to stand after addition of chlorine for a period equivalent to that provided by the plant sedimentation basin or clear well, whichever is to be utilized for break-point treatment. During testing, the sample should be kept at the temperature of the water in the plant and away from strong light.

5. *Residual Chlorine.*—At the end of the desired contact period, determine the residual chlorine in each sample. Ortho-tolidine may be used for residuals up to 1.0 ppm. For values in excess of 1.0 ppm. titration with sodium thiosulphate is recommended. Plot the results.

6. *Tastes and Odors.*—Taste and odor determinations should be made on all samples at the end of the contact period selected. (See Item 4.) It is desirable that these values be recorded as Threshold Units though the original standard methods procedure of taste and odor designation may be used where threshold odor equipment is not available.

Suggested Procedure for the Application of Break-Point Chlorination

A. Preliminary Laboratory Tests

1. Break-point test on raw water or raw water containing coagulants.
   a. Check residuals at various chlorine applications at the end of 15 minutes, 30 minutes, 1 hour and 2 hours contact. Note point at which total color is produced instantly after addition of ortho-tolidine.
   b. Check pH of each sample.
   c. Check color of each sample before and after filtering through filter paper.
   d. Check effect of chlorine on coagulation.
   e. Check odor.
   f. Plot chlorine residual results. Plot other results if desirable.
2. Coagulation test.
   a. Select chlorine application on raw water producing desired break-point residual.
   b. Add dosage selected to series of jars and apply varying amounts of coagulant while stirring.
   c. Stir at high speed 3 minutes.
   d. Stir at low speed an additional 12 minutes.
   e. Allow floc to settle and record observations.
   f. Determine pH value of all samples.
   g. Determine color (true and apparent) of all samples.
   h. Plot results.
   i. Repeat above using different chlorine applications.

B. Plant Application

1. Start with application giving best results under A.
2. Apply chlorine as near plant influent as possible and ahead of other chemicals where possible.
3. Best results appear to be obtained by maintenance of approximately 1.0 ppm. free available residual on top of filters.
4. Aerate just ahead of filters where possible (0.10 c.f./gal./min. appears to be sufficient).
5. Try effect of 1.0 ppm. free residual leaving the plant. It has been our experience that odors will be stronger at low residuals, 0.10-0.20 ppm., than at higher residuals.
6. Optimum pH range for break-point reactions is between 6.5 and 8.5.

C. Control

1. Use Laux Flash Test or Ortho-tolidine-Arsenite Test.
2. Use Ortho-tolidine-Arsenite Test occasionally to check for presence of interfering substances.
3. Make tests at least hourly. Keep record of both 5-second and 5-minute readings after addition of ortho-tolidine.
4. Check residual of effluent as in C-1, C-2 and C-3.
5. Determine residuals in the system using 5-second and 5-minute readings.

D. Bacteriological

1. Total count at 37.5° C and 20°C on:
   a. Raw.
   b. Top of filters.
   c. Filtered water.
   d. Finished water (laboratory tap).
   e. Distribution system.
2. Gas-forming bacteria 48 hours at same points as in D-1.
3. Observe and record turbidity, scum and sediment in tubes.

E. Interpretation

1. Compare all results with results obtained prior to adoption of break-point chlorination.
2. Do not jump to conclusions within a day or two after the start of the process. Experience indicates that considerable time may elapse before the system will come to equilibrium.

The dump area shown below has been converted into a skeet range by proper filling.

The Army Outlaws Garbage Dumps

By **RODNEY R. DURHAM**
Corps of Engineers

THE dumping and burning of garbage and combustible trash is no longer permitted at Army installations. All existing garbage dumps are being cleaned of pests, covered with dirt or ashes, and treated to blend with surrounding landscape. The only permissible dumps are those used solely for the disposal of non-combustible trash and large debris such as tree trimmings, stumps, and similar bulky materials. These dumps are strictly regulated as to contents and appearance.

During the early war period, 1941-42, when new camps were constructed rapidly all over the United States and old camps were enlarged suddenly, capacities of incinerators were continually outgrown. New incinerators could not be constructed soon enough to meet the need. Consequently, at nearly every camp, garbage and refuse was being burned in the open.

You may wonder why the Army now says "No" to a custom that is still prevalent in most communities in the United States. Here are the reasons:

Army dumps were generally isolated on the reservation and, except for occasional smoke and odor nuisances, were "out of sight, out of mind." But that happy oblivion did not last long. The dumps soon became infested with rats, flies, mosquitoes and other pests that migrated to the living quarters of the posts. Investigations by the Chief of Engineers and the Surgeon General revealed that the dumps were providing a breeding place for this vermin. Rats and flies flourished handsomely on the daily replenishment of food supply, and harboring and breeding places were ideal. Upturned tin cans, old tires, broken bottles, and other receptacles which accumulated and retained water created an utopia for mosquitoes and other insects.

It became obvious that whatever savings in costs might have been expected by using a dump instead of providing approved disposal facilities were to be dissipated by the necessity for instituting vigorous vermin control programs. Also, the overall effectiveness of camp-wide control programs was reduced as long as the dumps were in operation.

Other costly adjuncts of the so-called "cheap" dump came to light. The long haul to a far-away dump meant increased collection costs—more manhours, more gasoline, more wear and tear on tires and trucks! Many tires and even trucks were burned by rapid spreading of fire when combustible materials were unloaded on live coals. Also, many trucks were damaged by backing over high dump faces.

Realizing the false economies of the dump, the Chief of Engineers set out to provide approved disposal facilities at all posts, camps and stations. Sanitary fills were generally installed because of their low installation and operating costs; incinerators were installed where sanitary fills could not function correctly; and burning pits were installed at depot type installations. As soon as posts were provided with suitable disposal facilities, dumping of garbage and combustible trash was prohibited.

The Army is proud of the example it has set in refuse disposal. Many former Army Engineers are now back in civilian engineering practice, and from the inquiries for information received by the Chief of

A typical open dump; see photo above.

Engineers, it is plain that they are introducing to cities and towns the Army way of getting rid of potential health-hazards and disgraceful eyesores created by garbage dumps.

Labor Costs on Contract Highway Construction

An analysis, predicated on contract payrolls, has been made by the Pennsylvania Highway Department, to show the percentage of highway contract construction cost directly chargeable to labor. This analysis, which was published in the most recent report of the Department, shows the percentages of direct labor cost as of September, 1942, and January, 1944.

The 1942 costs directly chargeable to labor show a weighted average of 29.3%, and are as follows for the various types of surfaces: Native stone base course 28.99%, weighted, with a range from 16.53% to 48.41%; cement concrete pavement, 30.70%, weighted, with a range from 17.72% to 45.61%; resurfacing on existing base, 22.45%, weighted, with a range from 12.35% to 35.16%; flexible base course, excluding native stone, 27.35%, weighted, with a range from 12.45% to 39.92%.

The 1944 costs show a weighted average of 32.82%, with the various types of surfaces, weighted average and range, as follows: Plain cement concrete, 23.15% and 16.60-43.30%; reinforced concrete pavement, 38.11% and 18.35-40.78%; native stone base course, 24.98% and 17.39-39.62%; flexible base course, 29.79% and 22.40-40.84%; resurfacing, 21.09% and 13.50-25.70%; I-beam bridges, 33.94% and 28.18-36.62%; reinforced concrete bridges, 26.71% and 20.68-40.34%; steel truss bridges, 31.47% and 18.94-40.75%.

Concrete Pipe Manholes

(Continued from page 31)

ated, the following tabulation of bids as they were received from one of the contractors who has had experience with concrete pipe manholes indicates the economy of using this new type of manhole:

Depth	*Concrete Pipe Manhole*
10′-12′	$185
12′-14′	210
14′-16′	245
16′-18′	285

The cost of a manhole varies with the area in which any given project might be constructed because the costs of labor and materials differ in the various sections of the country. Labor costs are reduced by installing concrete pipe manholes because of the time saved and because a minimum of skilled labor is required. With the present demand for bricklayers, many municipalities will welcome such a design as a relief from their labor problems.

High Expansion Cements and Prestressed Reinforcing

In practice the efforts of prestressed steel reinforcement may be largely counteracted by shrinkage, immediate and retarded elastic reactions, and plastic deformation. The residual compression due to the prestressed reinforcement is relatively small unless use is made of high-tensile steels, as suggested by Freyssinet. The paper advocates the use of a cement which expands during the setting and hardening period, the reinforcement being placed under tensile stress by the actual expansion of the surrounding material. Proprietary cements of this type have been developed in France during recent years. They consist of an artificial Portland cement blended with a sulpho-aluminous cement (the expansive constituent) and a "stabilizer" the function of which is to absorb the reactive calcium sulphate and thus to check the expansion. The rate of expansion can be controlled by adjusting the proportions of the three main constituents. The course of expansion is compared graphically for high-expansion, Portland and low-shrinkage contents. High expansion sets slightly more slowly than Portland cement; the proportion of mixing-water required is about the same, but full expansion does not occur unless the concrete is kept wet after placing. At 28 days the strengths of high-expansion cement and Portland cement mortars are almost equal. An account is given of several series of tests to determine the influence of the proportioning and of the method of compaction of concrete made with high-expansion cement. Tests on arched beams and beams with curved soffit were carried out in a specially designed apparatus in which tensile stresses were applied by means of a jack.—H. LOSSIER : *Génie civ.*, 1944, 121 (8), 61-5. (Part I only.)—*Road Abstracts.*

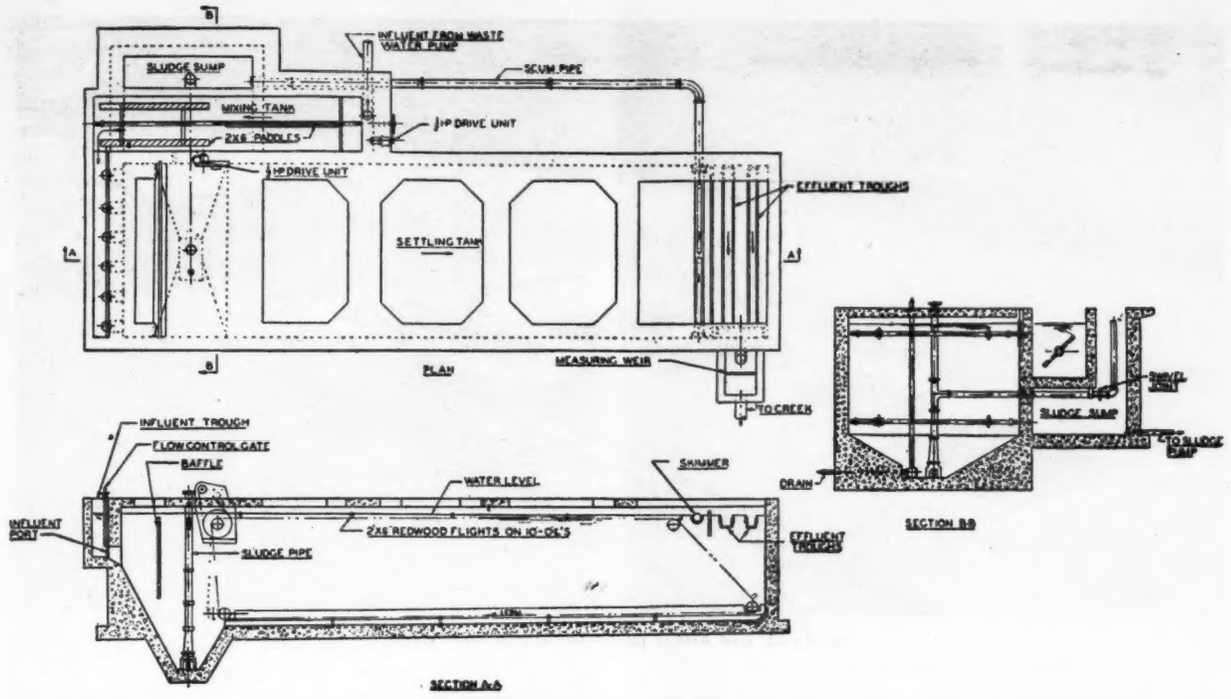
Municipal Insect Control

(Continued from page 30)

One or all of these insects may constitute a municipal problem. Whatever the local problem in insect control may be, a carefully organized program is necessary to achieve success. A suggested guide for municipal insect control follows:

1. Survey the problem and evaluate the extent of control needed against the specific types of insects in your community.
2. Determine what equipment, materials and personnel are needed.
3. Organize a cooperative control program under the supervision of the municipal health department, and make provision for a compact, efficient working group.
4. Solicit the participation of the public whenever indicated, for example in fly control and pest mosquito control.
5. Keep the public informed as to the importance and extent of the program.
6. After completing the initial control project, resurvey it as an index to future projects of the same type.

The procedures mentioned above can be administered by any capable, industrious municipal official. However, because of the many insects which may be troublesome, and the complex control measures which are justified at times to conserve life and property and to afford community comfort, municipalities should call on entomologists for service and cousultation. Larger communities might well include such a scientist on their staff to conduct surveys and to supervise subsequent control. The Sanitary Engineering Divisions of State Boards of Health can be of much aid. A very large proportion of State sanitary engineering staffs served in the Sanitary Corps of the Army and had first-hand experience in this type of war. Their advice will be of real and practical value.



Plan and section of the treatment plant.

Treating Paper Mill Waste

Waste white water is treated by bar screens, coagulation with alum and soda ash, and sedimentation, resulting in 90% reduction in BOD.*

By ARTHUR W. REDLIN* and J. J. GILBERT*

LAGOONING of waste white water was found not practical in the prevention of stream pollution at the Beach and Arthur Paper Co. plant at Modena, Pa. This mill has an average capacity of 30 tons per 24 hours and operates on a 6-day week; 65% of the production is on 6 colors and white manifold and writing paper, with the remainder on die wipe and napkin paper. Bleached sulphite is the principal pulp used. The first step was to provide a complete white water recirculation system, with the minimum use of fresh water. It was decided to treat all mill and floor drain and bearing cooling water to prevent untreated water from entering the stream. E. G. Wagner, borough and consulting engineer of Downingtown, Pa., was retained to design the treatment plant.

Flow tests showed that 14,000 to 18,000 gallons of waste were produced per ton of paper manufactured. On a 25 ton-per-day production basis, this results in a waste volume of approximately 450,000 gallons per day. Tests in the chemical laboratory of the plant indicated that with proper chemical dosages, a mixing period of 15 minutes and a settling period of 4 hours would produce a satisfactory effluent. The plant was designed for these detention periods but increased production to 30 tons per day has since increased the average flow to 540,000 gallons per day and reduced the actual mixing time to 12.5 minutes and the settling period to 3.2 hours. All surplus white water passes through a 70-mesh cylinder mold type save-all before being discharged to the waste treatment plant. The solids reclaimed from this save-all contain about 92 per cent moisture and are returned for re-use.

Treatment Plant

The wastes first pass through hand cleaned bar screens with ½ clear openings. These screens are located at the influent end of a pump sump where alum and soda ash are added so that a flash mix is accomplished as the waste is pumped to the mixing tank. The waste pump is of the centrifugal type and has a capacity of 1100 gpm but is throttled to give a somewhat reduced discharge. (This pump was the only one available at the time.) Dry feed machines are used for feeding alum and soda ash.

The main treatment units consist of a mixing tank 5 ft. wide x 5 ft. water depth x 25 ft. long having a capacity of 4,680 gallons; and a settling tank 16 ft. wide x 10 ft. average water depth x 60 ft. long having a capacity of 72,000 gallons. The waste and chemicals (alum and soda ash) while passing through the mixing tank are flocculated by a slow horizontal shaft mixer. Experience has shown that a mixing period of 30 minutes would probably result in a quicker settling floc with a reduced chemical dosage. The flocculated wastes then enter the settling tank which is equipped

*Mr. Redlin is vice-president in charge of manufacturing of the Beach and Arthur Paper Co.; Col. Gilbert is in charge of the Sanitary Engineering Division of the Link-Belt Co. This article is republished, somewhat condensed, with permission of *The Paper Industry and Paper World.*

The Beach and Arthur paper waste treatment plant.

with a sludge collector. This sludge collector serves a dual purpose in that it collects the flocculated solids, which settle to the bottom, in a hopper at the influent end of the tank and the scum, which floats on the surface, at the effluent end of the tank. The sludge is withdrawn from the hopper to a sludge sump by means of a swivel pipe under hydrostatic head. A skimmer removes the floating scum to the same sludge sump.

A centrifugal sludge pump discharges the sludge to a lagoon of one million gallons capacity. Withdrawal of the liquid waste from the settling tank is by means of two steel effluent troughs from which it flows into the west branch of the Brandywine Creek.

Operation and Results

The plan is designed so that the operation is as nearly automatic as possible, one man operating both the water filter plant and the waste treatment plant. The bar screens must be cleaned several times a day so that the larger solids are not forced through the bars where they would clog the foot valve on the waste water pump suction line. This pump operates automatically on a differential float control in the sump. The high pumping rate of the waste water pump causes surges through the mixing and settling tanks. Consideration is being given to the installation of one 300 gpm pump to pump continuously and a duplicate pump to be float operated and to take peak loads. The chemical feeders are filled once a day and regulated so that the average feed is 100 lb. of alum and 50 lb. of soda ash per day, or about 24 ppm of alum and 12 ppm of soda ash. Best results are obtained when a pH of 6.2 to 6.3 is maintained on the effluent at the creek. The slow mixers and the sludge collector run continuously with sludge being withdrawn and pumped to the lagoons for a period of about one hour every morning.

The length of the pumping period depends on the time required to remove all the sludge from the settling tank. Tests are now being planned to determine if the operation of sludge collectors can be reduced to several hours per day.

During the early months of operation of the waste treatment plant, the sludge from the settling tank was pumped to a save-all of the blanket type equipped with a coarse paper mill weave felt. This save-all reduced the moisture content of the sludge from approximately 96 per cent to 82 per cent.

It was felt that this sludge or reclaimed solids could be used in a nearby board mill, however, after several months use it was found that the per cent of long fibers was too low and the ash content too high. The reclaiming of this material was discontinued and the sludge pumped to a lagoon of one million gallons capacity.

After eight months of operation, this lagoon was practically full and a second lagoon was provided. It is contemplated that the sludge in the first lagoon will dry sufficiently to be removed prior to filling of the second lagoon. Two one-inch garden hoses connected to floats are used to decant the clear liquid from the surface of the lagoon. A float controls the sludge pump so that the sludge sump is automatically emptied when it becomes full.

Even when operating at about 115 per cent of its design capacity, the results have met expectations. The Pennsylvania State Department of Health sampled the Brandywine Creek above the plant, the untreated wastes and the treated wastes with the results as shown herewith.

	Stream Above	Untreated Wastes	Treated Wastes	Per Cent Removal
Turbidity	25 ppm	700 ppm	40 ppm	94
Total Dissolved Solids	140 ppm	220 ppm	280 ppm	..
Vol. Dissolved Solids	80 ppm	100 ppm	120 ppm	..
Fixed Dissolved Solids	60 ppm	120 ppm	160 ppm	..
Total Suspended Solids	30 ppm	520 ppm	40 ppm	92
Vol. Suspended Solids	30 ppm	460 ppm	40 ppm	91
Fixed Suspended Solids	0 ppm	60 ppm	0 ppm	..
Oxygen Consumed	3.8 ppm	52 ppm	9.6 ppm	..
Total Alkalinity	31 ppm	26 ppm	32 ppm	..
B.O.D. (5 day)	2.2 ppm	145 ppm	14 ppm	90
pH	6.9	6.4	6.3	..
2 hour Settleable Solids	.05 ml/l	65 ml/l	2.0 ml/l	..
8 hour Settleable Solids	.05 ml/l	55 ml/l	2.0 ml/l	..
OTHER DATA				
Tons of product per day			28.5	
Gallons of waste water per day			520,000	
Gallons of waste water per ton of product			18,400	
Total sewage B.O.D. population equivalent			364	
Sewage B.O.D. population equiv. per ton of product			13	
Volatile S.S. in lb. per ton of product			6.1	
(During this survey a clean-up occurred on one of the two machines at this mill.)				

Operating results at the Beach and Arthur plant.

Public Works Engineering Methods and Data

Methods of Stabilizing Embankments at Terminal Island

RELOCATION of a portion of Pacific Coast Highway (formerly State Street) and its construction as a freeway to carry the highway over the Terminal Island Freeway, the tracks of the Union Pacific Railroad, and the tracks of the Los Angeles City Harbor Department on separation structures, was started in June by the California Highway Dep't.

Because of the unsettled nature of the area through which this highway passes—settlement of 0.2 feet to 0.4 feet during 1941-43 has been recorded—the high embankments require the installation of vertical sand drains to puncture impervious strata and tap the water storage in the pervious layers.

The water storage is being tapped in order to minimize the increase in water pressure which is anticipated due to the added load when embankments are constructed. Such increase in water pressure material of the type found in the many-layered formation throughout this project tends to cause a lateral flow of material.

The controlled rates of construction of the embankments are one foot per day or three feet per week maximum.

Sand drain construction is the first operation on this project. Several methods of constructing the holes, in some cases to be 50 feet deep, have been studied, and tried.

The method adopted on this project is to sink a casing and jet the material out, around the outside of the casing. After the holes have been completed, they are backfilled with a clean coarse-graded sand to allow for the upward passage of water.

A two-foot layer sand-blanket is to be constructed the full width of the embankments to permit lateral escape of water rising from sand-filled drains.

James I. Barnes Construction Co. is the contractor. Frank B. Cressy is Acting District Construction Engineer and W. D. Eaton is Resident Engineer, both for the State. The work is described in California Highways and Public Works.

Highway Maintenance Operations in Wayne Co., Mich.

Maintenance operations in Wayne Co., Mich., are carried on from five yards located as nearly as possible to the best advantage for the work. Three of these yards maintain equipment repair facilities with the principal repair shops and yards located at Wayne, Michigan. At the Wayne Yard are located the main automotive and equipment repair units, machine shop, blacksmith shop, carpenter shop, sign shop, etc. These shops are operated by the Maintenance Division, and in addition to all equipment repair and other shop work incidental to maintenance, the entire facility is available to other County Road departments.

Yard facilities at this location include an asphalt plant, a bulk cement plant and hoppers for charging truck mixers. These are recent additions that have proved invaluable to maintenance operations.

Equipment used in maintenance consists of all types of construction and road equipment. Additional equipment secured in the 1945 fiscal year consisted of two 3,000-gallon street flushers, an elevating grader, three automatic truck loaders, a tandem three-axle roller and other tractors, pumps, air compressors, etc.

Another piece of equipment obtained in 1945 is the road magnet. This consists of a magnet suspended from a truck with a gasoline driven generator that supplies the energy to activate the magnet. During the course of the summer season approximately 6.5 tons of bolts, nails and miscellaneous scraps of iron and steel were collected from the roads by this unit.

Water Works Reservoir Cleaned by Bulldozer

By GLENN DUNCAN

Water Superintendent, Northville, N. Y.

The bulldozer, which gained fame throughout the war in the building of the Alcan Highway, air bases throughout the Pacific, and the Lido and Burma Roads, was put to good use by the village of Northville, N. Y., in the early part of August, 1946, when the water works reservoir was cleaned. The capacity of the reservoir when constructed was four million gallons, but this was reduced by silting. Sketchy cleaning methods of previous years were only partly effective. In September, 1945, a heavy storm caused violent discharges of water over the spillway of the upper dam and scoured away many tons of earth, which were discharged into the lower reservoir. Although the spillway and two dams were severely taxed, the experience bore testimony to the sound engineering practice of providing adequate spillway capacity.

In cleaning the lower reservoir, the mud pipe was opened and as the water drained the bulldozer followed the receding water line. One short bank and the dam were cleaned by hand as they were too steep for good bulldozer operation. All banks were flushed under pressure from a 500 g.p.m. mobile gas driven fire pump and hose unit.

The 10-ton bulldozer used in this operation was rented from a local company for $40 a day. In this operation, the bulldozer was used to push the mud and slime on the bottom of the reservoir toward the mud pipe, where it was sluiced through with water from the upper reservoir. In moving the silt forward, the method employed was to excavate a channel-way. As the water accumulated behind the mud plug in the channel lane, the operator would rupture the earth dam, or plug, allowing the water to sluice the mud forward toward the drain.

The Northville reservoir is approximately four hundred by fifteen hundred feet in size. It is estimated about three feet of silt and debris were removed, making a total of about 66,000 cubic yards. Five men were employed over a period of four days and the bulldozer was used only three days.

Large boulders on the floor of the reservoir interfered somewhat with the operation. To overcome this interference in future cleaning operations, it is in-

tended to remove these boulders by blasting, burial, or by dragging them from the reservoir. Despite the boulders, the operator was able to maneuver the bulldozer around them and move most of the accumulated silt out of the reservoir.

It is believed that the original capacity of the reservoir has been restored at reasonable cost and that the sides and floor of the reservoir basin are in as good condition as they have ever been.—From the New York State *Water Works News*.

Lost and Found, or Experiences of a Sewer Maintenance Crew

By A. B. UZZLE, JR.

Assistant Superintendent, City Water Department, Raleigh, N. C.

HAVE you ever dropped your false teeth, or your watch, your ring, or money into a sewer? Such losses have often been reported, and many of the articles have been found by sewer cleaning crews.

On one occasion a local dentist answered his telephone and was informed by the city sewer maintenance foreman that a set of false teeth had just been taken from a stopped-up sewer line. When the identifying markings were checked it was found that the teeth had been made by another dentist in the same city. The teeth were turned over to him, none the worse for their travels.

Another time a lady reported the disappearance of two diamond rings of great monetary value and even greater sentimental value. She was sure she had accidentally flushed them into the sewer. During the next several months the city sewer maintenance crew inspected manholes on the sewer main leading from her home every two or three days. In an effort to claim the $1000 reward offered for the recovery of the rings they also dug up and looked into the pipe connecting her home to the sewer main. Still no rings. Finally, several months later, a member of the maintenance crew told that he had dreamed the night before of finding the rings in the second manhole below the house. On the strength of this the crew decided to look again. Sure enough, the diamond rings were found, not in the second manhole, but in the first one below the house. The reward of $1000 was paid to the foreman, who gave each of his two helpers $100. As a result of a local newspaper account of the finding the foreman was swamped by automobile salesmen and was soon minus his $800. The wife of one of the helpers, who had not lived with him for some time, returned and stayed long enough to spend his share. What become of the second helper's $100 is not known.

The sewer maintenance crew hardly ever goes through a night or a holiday without receiving a call to unstop a sewer. One Christmas night a sewer located near the City Hall was reported stopped up. Efforts to rod out the line failed so the pipe had to be dug up. When the pipe was finally opened it revealed a grand collection of pistol bullets and cartridges from the Police Station in City Hall, and a quantity of spoons, knives and forks from several nearby cafes.

More times than they can remember workers of the cleaning crews have been several dollars richer after a trip probing into manholes. One pocket alone netted about a peck of assorted material including eight dollars in silver coins. Over a dozen watches have been removed from sewers by the present cleaning crew, but unfortunately these were no longer good after being submerged.

Soil Characteristics for Mudjacking Studied by New Jersey

By F. D. WOODRUFF

Assistant Superintendent of Maintenance, New Jersey, State Highway Department.

THE New Jersey State Highway Department has, for some time, been engaged in studying the characteristics of soils suitable for mudjacking. Deposits of soil believed suitable for mudjacking are located. Samples of these deposits are submitted to the Testing Division for analysis and determination of strengths for various proportions of cement and admixtures. The slurry now used generally contains approximately seven (7) bags of cement per cubic yard of soil, plus calcium chloride in an amount equaling two per cent of the weight of the cement.

Investigations and tests have shown that most soils which are essentially loam are not satisfactory for mudjacking purposes because of failure to harden even in combination with considerable quantities of cement. Therefore, where obtainable, soil containing a fairly large percentage of fine sand is being used. These sandier soils show a very marked improvement over the loamy soils with respect to the strength developed. They are open to the objection, however, that because of their abrasive nature they tend to cause excessively rapid wear on pistons and cylinders. Furthermore, if the sand content is high they tend to clog or jam at certain points in the equipment resulting in serious damage to parts. These difficulties have been very largely eliminated, however, by adding to the mixture approximately 17 pounds of hydrated lime per bag of cement. This added lime tends to "fatten" the mixture, act as a lubricant, and maintain the sand grains in suspension without materially reducing the strength.

The work with sandy materials is, however, still in the experimental stage. Further experimentation with various soils, proportions, and admixtures will be carried on. Certain changes in the design of the equipment to further facilitate the use of sandy slurries are being considered. Bituminous slurries have not been used. Experimentation with bituminous slurries is, however, being considered. Central mixing plants are now being established. At these plants the materials will be proportioned and mixed. Delivery will be made to the job in a dry condition where water will be added in an amount subject to the discretion of the foreman.

The minimum time set for closing the road to traffic after mudjacking is variable, depending entirely upon traffic conditions.

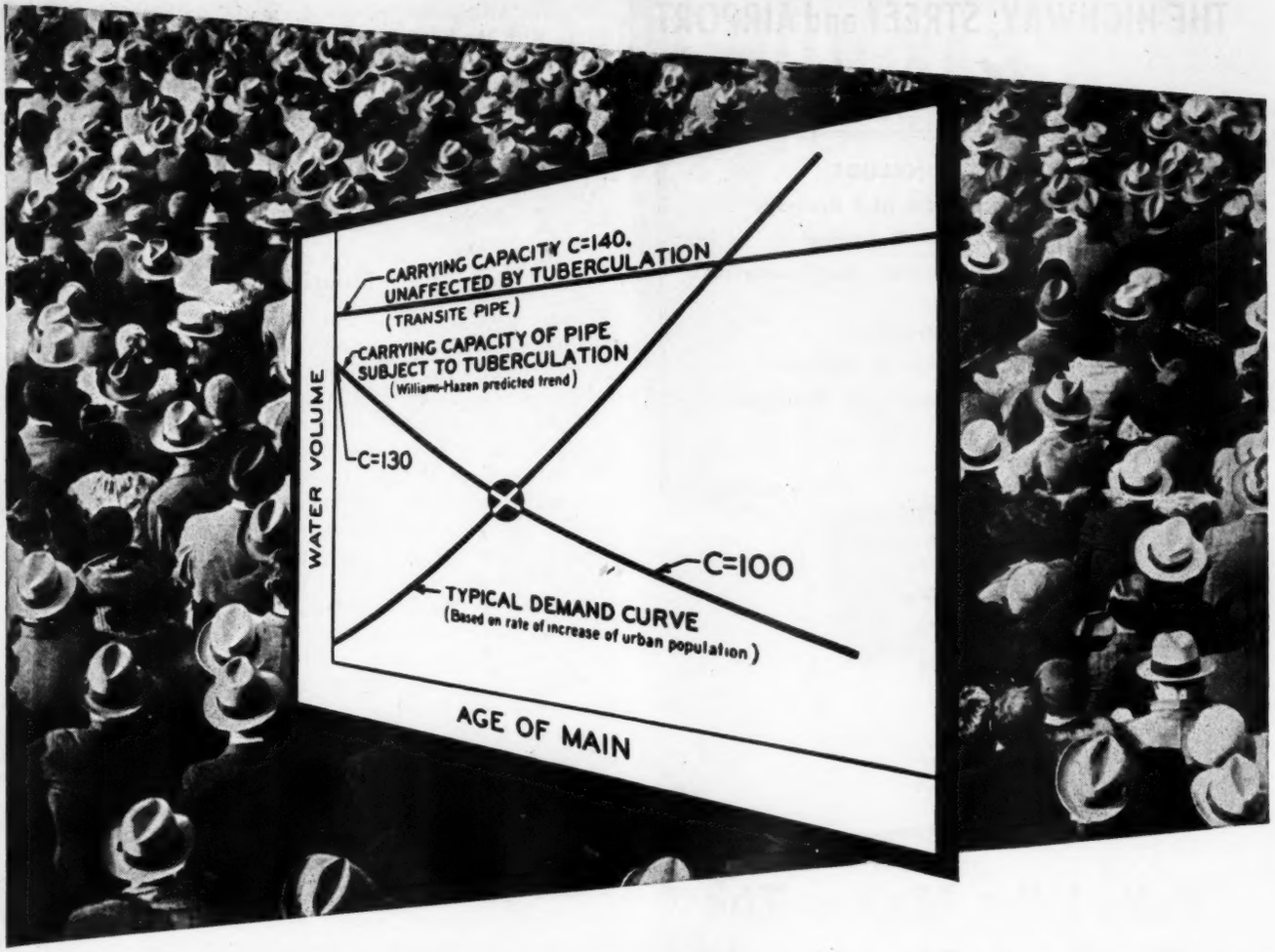
An analysis of what the writer considers one of the best soils yet encountered is as follows:

Passing 10 Mesh	100%
Passing 40 Mesh	94%
Passing 60 Mesh	86%
Passing 200 Mesh	38%
Finer than .05 MM	30%
Finer than .005 MM	5%
Finer than .001 MM	2%
Elutriation	38%
Weight per cu. ft. loose	83.19 lbs.

This soil developed a strength as used of 766 pounds per square inch.

Plywood Highway Signs

Before the war, nearly all highway signs were of pine lumber, ¾ in. or thicker, and were ordinarily made up of 6-inch boards joined together by cleats on the rear of the sign. During the war, the Connecticut Highway Department investigated thoroughly



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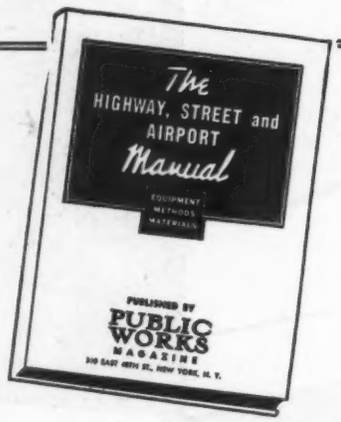

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the possibilities of plywood, made with waterproof glue, with the surface dipped in a resin to waterproof it further. Considerable information was obtained from manufacturers of gliders and airplanes, and specifications were drawn up for a 3/8-in., 5-ply plywood that will be used in the manufacture of the majority of the Highway Department's future signs. A saving is anticipated because the new plywood sign will be lighter and more durable.

Fluorine

Fluorine is a nearly colorless gas about 30 per cent heavier than air. It is ninth in the series of elements in the periodic table with an atomic weight of 19 and is the first element in Group 7, the halogens, which also include chlorine, bromine, iodine and Element No. 85, which has not yet been discovered. Fluorine has only one valence, —1, whereas the other halogens are multiple valence elements. Its atomic structure consists of a nucleus having a positive atomic charge of 9, an inner shell of two negative electrons and an outer shell of seven negative electrons. This is an unstable atom and has a tendency to pick up the extra negative electron in the outer shell. One pound of the gas at room temperature would fill about 10 cubic feet.

The gas can be condensed below the critical temperature of —129° C. to a liquid. Liquid fluorine boils at —187° C. under one atmospheric pressure. In physical properties fluorine resembles the fixed atmospheric gases, oxygen and nitrogen. It has an intense odor which some observers describe as similar to ozone, somewhat chlorine-like and highly irritating. The toxicity of fluorine is said to be about the same as that of chlorine.

Fluorine reacts vigorously with most metals at high temperatures. It also reacts strongly with silicon-containing compounds; thus, it can support continued combustion of glass, asbestos, etc. In its reaction with hydrogen, fluorine gives off five and a half times as much heat as in chlorine's reaction with hydrogen. Fluorine readily displaces chlorine and other halogens from the solid metal halides, such as sodium chloride or salt, and reacts immediately with water to form hydrogen fluoride, oxygen and some oxygen fluoride.

Fluorine can be handled at atmospheric or moderately elevated temperatures in metals; such as iron, copper, magnesium, nickel and monel. In these materials an adherent fluoride film appears to give the necessary protection to the metal surface. Fluorine can be observed for brief times in glass or quartz vessels at atmospheric temperature if it is quite free from hydrogen fluoride.

Testing the Performance of Bituminous Distributors

A method has been developed at the Road Research Laboratory, Harmondsworth, to test the efficiency of tar sprayers with the least interference with their work. The test is made on the road during the course of spraying, and requires no special fitting or alteration on the sprayer. A special "testing mat," consisting of a built-up band of paper about 18 in. wide, is laid on the road across the full track of the sprayer. After the passage of the sprayer the mat is dissected into its separate strips each of which has received the tar that would have fallen on to a numbered element of the road. The strips are folded so as to expose no fresh tarred surface, and weighed in the laboratory to enable the distribution of

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the tar to be determined. The mats have also been used in the laboratory in tests made on individual jets and combinations of jets of the whirling spray type to ascertain the reasons for variations in the spread of tar. *The Surveyor; Road Abstracts.*

Municipal Garbage Collection Insures Better Sanitation

Refuse collection and disposal by the municipality itself is preferable because such service can be performed more cheaply and community sanitation assured more readily under such a plan, according to a survey of garbage collection practices of 121 Minnesota municipalities by the municipal reference bureau of the University of Minnesota.

Other conclusions based on the survey, the American Municipal Association reports, are:

1. Some form of municipal collection is carried on in 38 of the cities, with a majority requiring compulsory service from one kind of premise or other.
2. Contract collection is less popular with such a system in operation in only 17 of the municipalities.
3. About 75% of the municipalities still allow private scavengers to make collections or property owners to haul their own refuse.
4. Private collection may be advisable for municipalities under 25,000 population depending upon care that scavengers take in observing public sanitation and official enforcement of regulations. However, private collection often is expensive because of the need for scavengers to make a profit and the difficulty of enforcement.
5. At least 106 municipalities in the state maintain dumps for refuse disposal; 14 exclude garbage from the dump while 46 carry on some kind of cover practice.
6. A sanitary fill or some systematic method of burial for refuse is practiced in 11 communities.
7. Five cities operate incineration plants, and are satisfied with results.
8. Hog-feeding is used in conjunction with other methods of disposal in 18 municipalities. Rochester and St. Paul operate municipally-owned hog farms.
9. Dumping and hog feeding as methods of disposal may be practical for smaller communities because of economy and simplicity, but sanitary precautions such as cover, vaccination and isolated location must be taken to prevent nuisances and endangering of the public health.
10. Incineration is the most approved method of refuse disposal, but municipalities have been slow in constructing plans because of their cost.
11. The sanitary fill is also a recommended disposal practice; it is preferred especially to the open dump and has economical advantages in connection with collection considerations and in reclaiming useless land.
12. Refuse collection and disposal operations are financed from general revenues in 39 of the 121 municipalities.
13. Predominant method of financing is the service charge; 14 municipalities with municipal or contract systems of collection follow such a method.
14. The best plan of financing is from general revenue because it assures complete service and is based on ability to pay. If funds are unavailable to cover complete service, however, service charges are an acceptable supplement or substitute.—*Public Administration Clearing House.*

Legal Decisions Relating to Highways

Taxation Exemption of Engineer's Fee

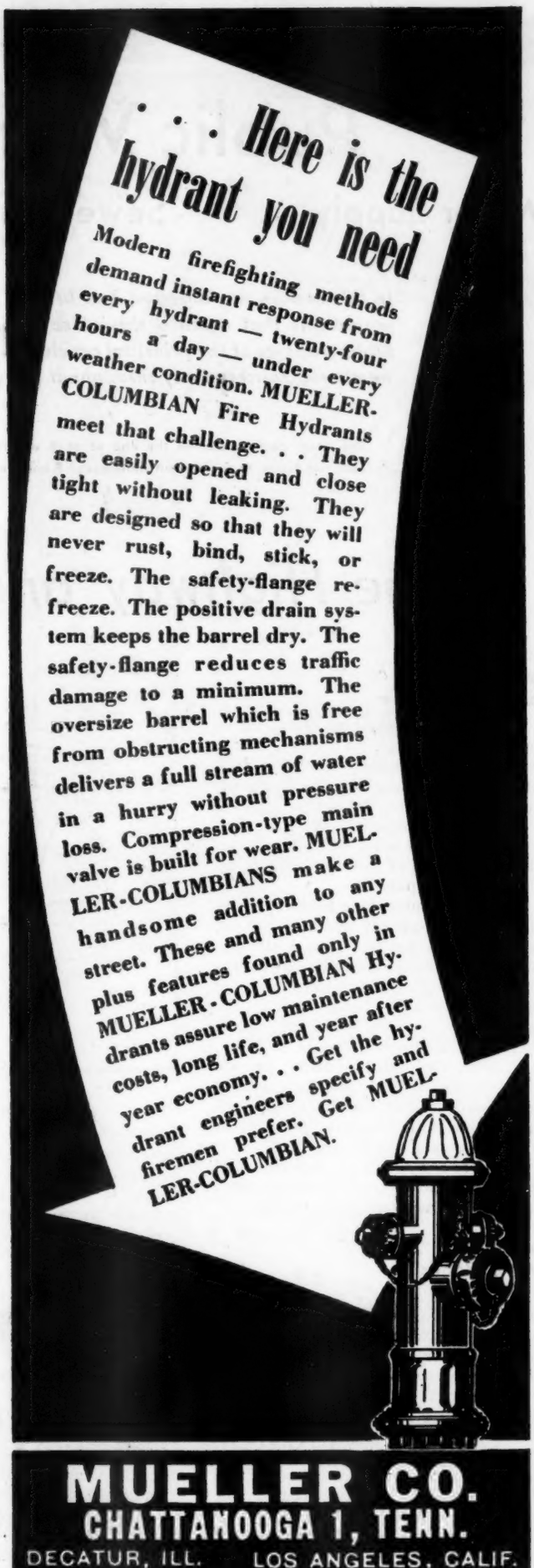
An engineer contracted with a Bridge and Highway District to furnish all the necessary engineering talent and material required for the construction of a bridge, including the services of such of his subordinates as might be necessary to plan, supervise and complete the construction of all engineering features at a percentage of the estimated cost of the bridge, the contractor being bound, by the contract provision against its assignment, to see the project through to completion. The Ninth Circuit Court of Appeals (Strauss v. Commissioner of Internal Revenue, 97 F. 2d. 549) held that he was an "independent contractor," and compensation paid him under the contract was not exempt from income tax. Both parties presented the case on the assumption that if the compensatoin was paid him as an officer of the district it was exempt from Federal tax.

Issuing Bonds for Road Purposes

Where more than 27 years have elapsed since the approval by the voters of the issuance by a county of bonds for road purposes, the Kentucky Court of Appeals (Sparks v. Sparks County, 192 S. W. 2d 724) said that the strongest point against the validity of a proposed bond issue and the continuation of a 20 per cent tax levy for payment of proposed road bonds, was, in addition to the long lapse of time and the radical change in the plans for building and maintaining highways, the fact that the retirement of the bonds by the continued levy of the maximum tax would have to be met by a new generation who had no voice in the election held 27 years ago. Between 1920 and 1940 the population had increased almost 50 per cent. "It would be unfair to a great number of the present population," the court said, "to impose upon the citizens a debt even of $50,000, with a 25 year tax of the constitutional limit, without giving a fair opportunity to express their present views."

"Extra Work" Provision Construed

The New York Court of Appeals (De Martins v. Elude Realty Corporation, 293 N. Y. 778, 58 N. E. 2d 519) hold that, where the provisions of a contract fixing the price to be paid for items of "extra work" clearly implied an obligation to do such extra work at a stipulated price as required in connection with the performance of work included in the "scope of the work" provision of the contract, the plaintiff's failure to do requested extra work would serve as a partial defense in an action to foreclose a mechanic's lien and for damages for breach of contract. The judgment of the Appellate Division (267 App. Div., 774, 45 N. Y. S. 2d 355) was reversed which held that the action would not be defeated because of the plaintiff's failure to install curbs and lay sidewalks, where the contract contained no language requiring the plaintiff to do so, but merely set forth an agreed price for such services under the caption "Extra Work"—a term meaning work independent of the contract and not required in its performance, as shown by the fact that these items were not included in the "Scope of Work" provision in the contract.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Public Works Digests

Water Supply · Sewerage · Highways and Airports

In this section are digested and briefed the important articles appearing in the periodicals that reached this office during the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each digest refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

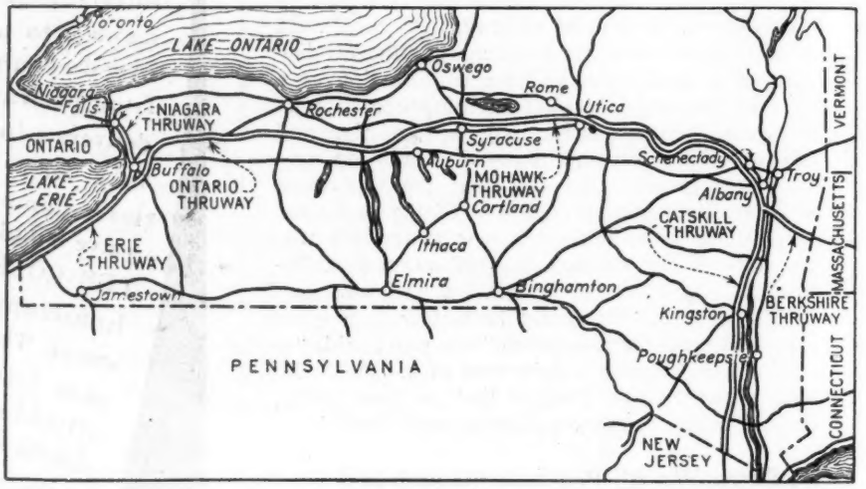
The Highway and Airport Digest

New York's Thruway

Ground was broken on July 11 on the New York State Thruway, which will extend 486 miles from New York City to Albany and west through the Mohawk Valley to Buffalo and thence to the Pennsylvania line. Within a belt extending for 30 miles on each side lies 50% of the area of the state, containing 90% of its population.

It will be a multi-lane highway, with minimum right-of-way width of 200 ft., sight distances not less than 1,000 ft., and 2800 ft. minimum radius of curvature. There will be no intersections at grade, and no advertising signs on the right-of-way or on adjacent lands. There will be two 25 ft. to 37 ft. lanes, with controlled access from private property. The bridges are designed for H-20 S-16 loading, with bridge railings in line with highway guard rails. Broad shoulders will be provided.

The Thruway will be toll-free and available for all types of motor traffic; the bulk of the traffic will be local.[R37]



Courtesy Better Roads

New York's projected "Thruway" System (shown in double lines).

Stabilized Gravel Roads

This paper before engineers of the Latin American republics described in detail the practices of the Michigan State Highway Dept. Following are some of the special points. The department constructs gravel surfaces by either the road-mix or the plant-mix methods. In the latter, gravel, binder soil and chemical admixtures are prepared in a pugmill stabilizing plant. The binder soils used have plasticity indexes less than 25, as those of higher plasticity index are difficult to disintegrate and mix uniformly. Clays of lower plasticity index are likely to be less affected by adverse weather conditions. It is often more economical to produce gravel aggregate low in fines and make use of a sandy binder-soil than to produce a sandy aggregate and stabilize with binder soils of high plasticity index. For this reason it is desirable to locate the binder first and produce the gravel to fit the binder. Procuring a satisfactory plant mix requires rigid field and laboratory inspection during production of the materials, in order to control variations in local deposits.

If the road is to be maintained as a gravel surface, the plasticity index should range between 8 and 12. If calcium or sodium chloride is used in dry seasons, the range should be between 5 and 9. If it is intended to use it as a base for a bituminous surface, the plasticity index of the gravel base should be held between 1 and 6; and the crown between 2" and 3" on a 20 ft. road. However, if the gravel surface is to be maintained as such, about 5" crown is advisable.[R40]

Air Entraining Concrete for Pavements

Certain substances when added to concrete in very small quantities have the power of introducing into the mass a larger amount of air than is found in ordinary concrete. However, unlike the air in ordinary concrete, this additional air appears to exist in the form of minute disconnected bubbles well distributed throughout the mass. The presence of these tiny bubbles materially

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alters the properties of both the plastic mixture and the hardened concrete. For example, air-entraining concrete is considerably more plastic and workable than ordinary concrete. It can be handled and placed with less segregation. The tendency of concrete to bleed or develop water-gain after placing is also reduced. Resistance to alternate freezing and thawing is improved to a marked degree by using air-entraining concrete. The ability of concrete pavements to resist scaling due to the use of salt or calcium chloride for ice removal is also greatly increased.

A total air content of 4 to 5% by volume will give satisfactory improvement in durability. Less than 3% may not give the required resistance to weathering, which is the primary purpose of using air-entraining concrete; and an excess of 6% may reduce the strength without contributing any additional protection.

Air entrainment can be secured either by using special cement to which Vinsol resin or Darex have been added during manufacture, or by adding them to the batch in the mixer. The latter permits more precise control of the quantity of air but introduces the hazard of mistakes due to the human element.

Air entrainment is affected not only by the use of special cement but also by the amount of sand, richness of mix, consistency of mix, type of mixing, and length of mixing time. There may be a tendency for air-entrained concrete pavement surface to tear under the screeds of the finishing machine and other finishing tools. As little water rises to the surface, it must be finished close behind the mixer, which permits desirable early protection and curing.[049]

Undersealing With Asphalt in Texas

During the last 18 months, Dallas Dist. of Texas Highway Dept. has undersealed 57 miles of concrete pavement with asphalt, earlier experience having shown that this is decidedly superior to sealing cracks and joints from the surface and to mud jacking with soil-cement slurry. It fills subgrade cavities, raises settled pavement and seals cracks and joints from below. The cost of undersealing 20 ft.-pavements has averaged less than $2,500 per mile for 19,000 gal. of asphalt placed through 1400 holes.

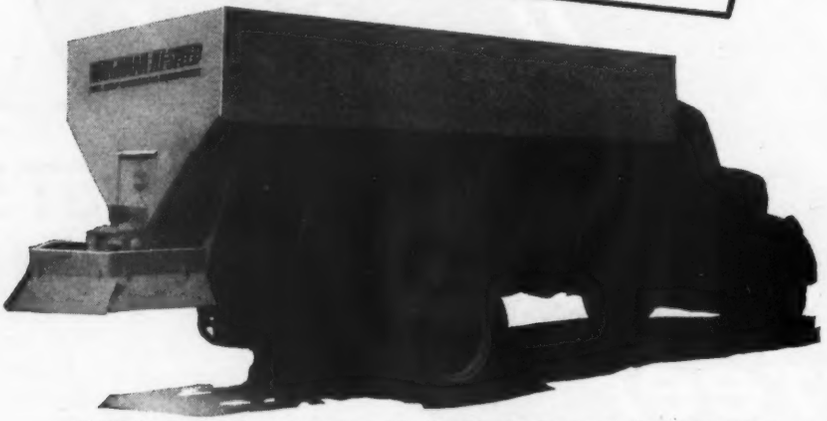
In placing the asphalt, three 1½" holes are made at each transverse joint in a lane, and additional ones where needed. A special tapered nozzle is driven into a hole and connected to a pressure distributor by two 1" hose lines, one applied to the pump and the other to the tank to permit circulation of the asphalt when it is not being forced through the hole. The asphalt used is 30-penetration with a melting point of not less than 185°. It is heated to 300° for unloading from tank cars and injected under the pavement at 400° to 500°. Pumping pressure is limited to 35 psi. Cores from treated pavements show that the asphalt reaches 2 to 15 ft. from the pump hole, with thicknesses of 1/16" to 2½".

A crew consists of 9 men—a foreman, nozzle man, helper to drive plugs, one to wet the pavement before asphalt is injected, 2 men filling holes after use, a flagman, 2 drillers and a compressor. Best results are obtained by undersealing in dry weather, as then the asphalt travels farther under the pavement, cavities are larger, and less steam is created under the pavement.[E33]

Airport Program For Wyoming

The Aeronautics Commission of Wyoming engaged a private engineering firm from another state to develop a 10-year program for constructing a statewide airport system, in order to obtain conclusions and recommendations free from bias or political influence. The report has been submitted, and gives a comprehensive 10-yr. program that will fit into and become part of the national airway system and provide for expansion during the next decade. Proposed airports were classified as major, feeder line, and small. Priority 1 was allotted to immediate construction; priority 2 to completing construction for the next 3 to 5 yr., and priority 3 to the balance up to 10 yr. Each site was considered as to suitability of location, terrain, type of soil, drainage require-

The Fast Efficient way to "Skid-Proof" Roads



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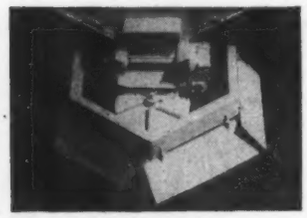

Close-up of spreader mechanism. Note special baffle plate guards . . . an exclusive BAUGHMAN feature.

Special baffle plates keep spread to desired area. No waste of material . . . no possibility of injury to pedestrians or damage to automobiles.

BUILT-IN HEATER keeps spreading material warm and free-flowing in the lowest temperatures . . . prevents working parts from freezing and becoming brittle.

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Rebuilding road shoulders—an easy job for the BAUGHMAN. Baffle plates and distributor are easily and quickly removed.

Baughman Model C. Spreader for dump bodies. Requires no hopper. Wide spread pattern. Positive-action. Economically priced.

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WINTER OF 1944-45	WINTER OF 1945-46
TOTAL SNOWFALL: 66 INCHES	TOTAL SNOWFALL: 78.5 INCHES
COST OF SNOW REMOVAL $88,582.86	COST OF SNOW REMOVAL $73,407.99

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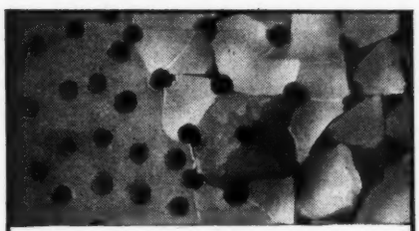

Sterling "Auger-Action" at work

- ★ Assures quick removal
- ★ Saves labor and equipment
- ★ Makes driving safe

Statistics tell the story. Last winter, with 20% more snow than the previous winter, a large eastern city reduced the cost of removing each foot of snow that fell by 30%! It did it with *Sterling* "Auger-Action" Rock Salt!

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YOU, TOO, CAN SAVE!

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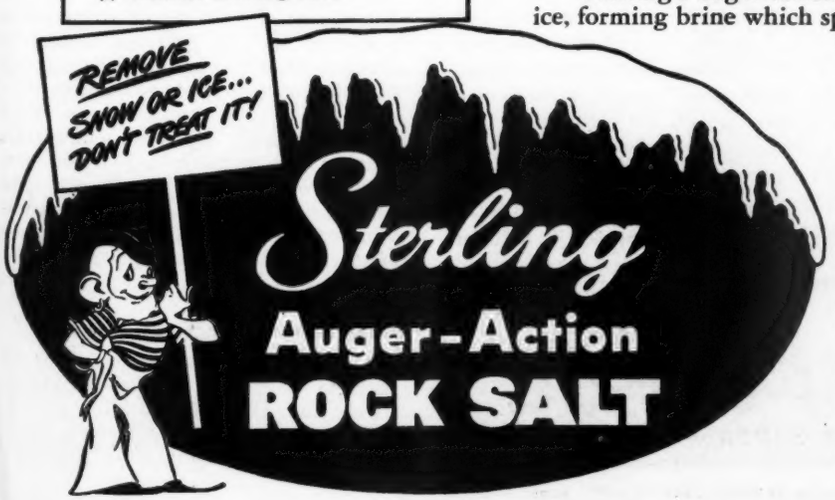
Sterling's auger-action also bores through compacted snow and ice, forming brine which spreads out, loosening the bond with pavement. Traffic shatters the mat, and the remaining brine prevents further icing. You're bound to save time, labor, money . . . receive wholehearted public endorsement.



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ments, lengths of runways, layout of runways in accordance with the wind rose, and adaptability to expansion. An aerial photograph was made of each site and proposed improvements sketched on it.[E32]

Armor-Coated Roads in Nebraska

In sand hill sections of Nebraska, far removed from deposits of clay and gravel, an armor-coated, bituminous-sand pavement has proved to have superior riding quality, longer life expectancy, requiring less maintenance and frequently to be more economical of construction, than unoiled, gravel-surfaced roads with clay binder. Some 280 miles of this type have been constructed.

For constructing the subgrade, better compaction of the sand is obtained with tractor and medium-heavy rubber-tired earth moving equipment than with sheepsfoot rollers. The materials used include natural sand with mineral filler added as necessary, and a bituminous binder, usually an MC-2, MC-3 or MC-4 cut-back asphalt, the grade depending on job requirements and weather conditions. Mixing may be done by either the blade-mix or traveling plant mix. First, filler is added sufficient to provide, for a 6" depth, approximately 20% of material passing a 200-mesh screen. This filler is thoroughly mixed with the sand by scarifying. Then, for blade-mix jobs, the asphalt is applied with a pressure distributor and thoroughly mixed with disk and blade grader. When a traveling plant mixer is used it cuts to a depth slightly under 6", which gives a compacted bituminous mat a full 5" thick. Best penetration of the bitumen is obtained if the mixture of sand and filler contains 3 to 5% moisture; but this must be reduced to less than 2% before compaction, by aerating and thoroughly mixing with tractor-operated disks, followed by large motor graders which cut to a total depth of about 4½". Usually the depth of cut is kept under 1" for the first pass of the grader, increasing for successive passes as the surface becomes compacted. When aeration and mixing are nearly completed, heavy flat-wheel rollers are used, with successive passes overlapping at least one-half the width of the roller. This is followed by several days maintenance with pneumatic tired rollers. The final operation is placing an armor coat, which consists of a light penetration seal coat of 0.2 to 0.3 gal. per sq. yd. of an RC-2 or RC-3 cut-back asphalt, followed by 12 to 25 lb. per sq. yd. of gravel. This is rolled with flat-wheel rollers followed by at least 3 days of maintenance with pneumatic-tired rollers supplemented by light road drags.

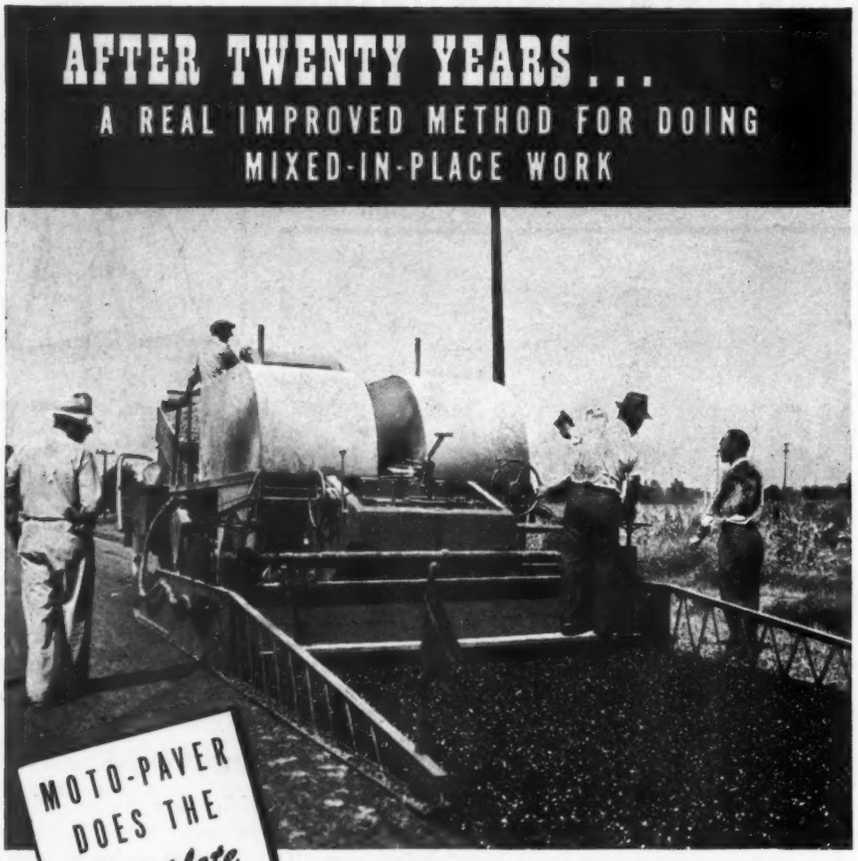
Embankment and cut slopes are protected by covering them with dry cured hay, about 10 lb. per sq. yd., weighted with a large shovel full of earth placed at 3-ft. intervals. This prevents serious surface wash of the sand, and the hay catches enough wind-blown dirt and grass seeds to form permanent protection.[E35]

Runways Without Expansion Joints

At the Fairfield-Suisun, Calif., Army Airbase, concrete pavement is being constructed for runways and taxiways without any expansion joints. The runway pavement is 200 ft. wide, built in eight strips 25 ft. wide. The middle six strips are 18" thick, increasing to 27" in each outside strip. Contraction joints were placed at 12½ ft. intervals, formed by placing metal strips in the freshly poured concrete and removing them after the concrete had taken its initial set. Expansion due to temperature changes will be minimized by the mass of the concrete, which will take some time to heat through. The concrete was vibrated by means of seven vibrators attached to the concrete spreader.[E36]

Equipment for Constructing Concrete Pavement

Contractors on the construction of the concrete pavement between Highland Creek and Oshawa, Ontario, are required to provide the following minimum amount of equipment: Two sub-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grade rollers; steel forms for at least 1,000 feet of pavement; a mechanical form tamper; subgrade machine (optional); steel subgrade templates; cement and aggregate weighing equipment; batch trucks; water supply units, one for mixing and one for curing and sprinkling; paving mixer with timing and water measuring equipment; vibrator; mechanical spreader; mechanical finishing machine; hand strike board; bulkheads for joints; scraper, with 25 replaceable blades in stock; at least 6 movable foot bridges; and edgers. Burlap is furnished by the department.[046]

Air Surveying for Highway Location

An air survey will not only provide a map for locating a road but also information concerning rock outcrops, soil condition, drainage channels, size and type of trees, etc. It can be cheap or expensive, depending on the nature of the job. The main factors affecting cost are accuracy, mapping scale, contour interval, details, size and accessibility of area, and extent of existing ground control. For an inexpensive survey with a scale of 2500 ft. to 1", the aircraft would fly at 15,000 ft. above mean ground level and photograph a strip 4 miles wide. By photographing three parallel strips overlapping 60%, a stereoscope will show the ground in relief and contour lines can be drawn.[047]

Bibliography of Highway and Airport Literature

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32. Ten-Year Program for Wyoming Airports. Pp. 85-86.
33. Asphalt Underseal Corrects Pavement Pumping Through Joints and Cracks. Pp. 90-92.
34. Heavy Rock Excavation in Kentucky Hauled With Earthmoving Scrapers. Pp. 104-105.

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35. Armor Coated Highway Construction Through the Sand Hills of Nebraska. Pp. 94-97.
36. Major Heavy-Duty Concrete Runway With No Expansion Joints. Pp. 102-103.

L *Civil Engineering*
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7. Radiant Heating Built Into Concrete Hangar. By Francis R. MacLeay. Pp. 444-445.
9. Stability of Runway Soils Determined by Ground-Water Vapor. By H. H. Houk. Pp. 446-447.

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46. Completing the Dual Highway Between Toronto and Oshawa. Pp. 57-60, 128.
47. Air-Surveying Methods for Highway Location. By D. N. Kendall. Pp. 61-62, 127.
48. Anti-Stripping Asphalt Additives. By John C. Sprague. Pp. 63-71, 116.
49. Air-Entraining Concrete for Pavements and Bridges. Pp. 72-73, 107.
50. Research on Frost Action in Soils. By R. M. Hardy. Pp. 74-76, 102.
51. Ontario's New Planning Act. By Dana Porter. Pp. 77-78, 103.

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42. Factors in Planning and Constructing Boardwalks. By Henry Garnjobst, Jr. Pp. 24-25, 36.
43. Good Practice in Drift Prevention and Ice Control. Pp. 29-30.

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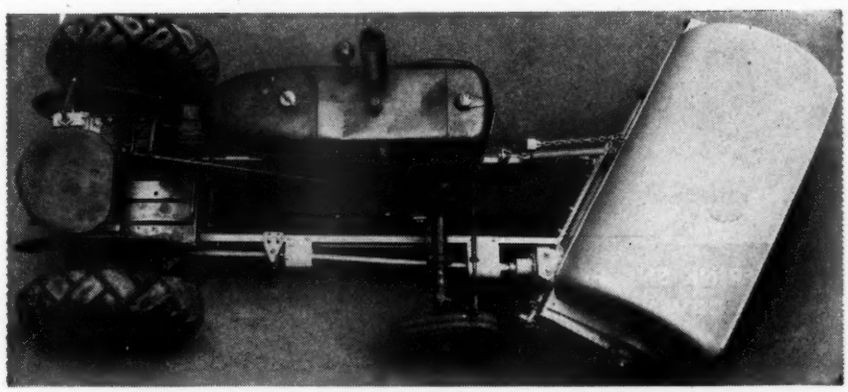

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R *Better Roads*
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37. New York Builds a Thruway Route. By Harvey O. Schermerhorn. Pp. 21-22, 34.
38. Revolution in Roads in Nigeria. By Mbonu Ojike. Pp. 23-26.
39. Does Your Accounting System Really Work for you? By Carl A Olson. Pp. 31-34.
40. Stabilized Gravel Roads in Michigan. By J. G. Schaub. Pp. 35-38.

X *The Highway Magazine*
October

4. Operation Snow Drift. By Arthur J. Yaw. Pp. 196-199.
5. Highway Underdrains. Do's and Dont's on Design and Construction. By A. J. Runnals. Pp. 200-202.

Oil-Concrete Research Project at University of Colorado

A research project for the study of the waterproofing of mortar and concrete through the use of petroleum derivatives has been established at the Engineering Experimental Station of the University of Colorado by The Texas Co. It is believed that even small amounts of asphalt and related petroleum derivatives may greatly increase water resistance and the flexibility of the concrete. It is already known that the addition of petroleum materials increases the amount of air that can be incorporated in the concrete mix, increasing the resistance to freezing and thawing. Professors Warren Raeder and William H. Thoman will supervise the project, assisted by D. G. Kretsinger, associate research engineer of the Engineering Experimental Station.

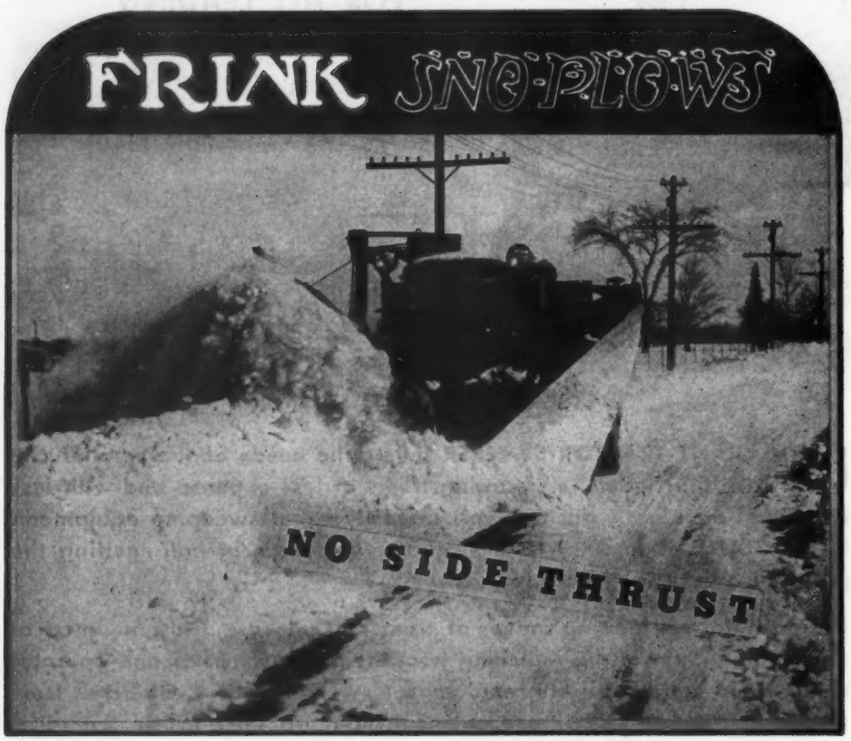
Turf for Airports in South Africa

The British Empire Flying Training Scheme necessitated the construction of new aerodromes and in many cases the renovation of existing aerodromes in South Africa. Turf was sufficient as heavy aircraft were not to be used. Consequently a survey was taken of soil types, climatic conditions and vegetation at every aerodrome in the Union and a large scale investigation was started at Pretoria on approximately 92 grass species. "Kweek" and "kikuyu" proved the two most suitable species, with Rhodes grass and Italian rye useful for nurse covers. Research, still in progress, was instituted into the production of quickly germinating seed. Soil preparation, planting procedure and maintenance are described at some length. For taxiways in frequent use and for warming-up areas, gravel or tarmacadam surfacings were used.—From *Turf & Aerodromes*, T. A. Linley: *Aerodrome Abstracts.*

Ohio Plans Early for Winter

The Ohio Department of Highways has worked out a system for storing rock salt that enables it to keep state roads safe for travel in spite of emergency situations created by sudden ice and snow storms. In July and August the Department requests its 12 division engineers to report on their requirements for the coming season, giving amount of stock on hand and estimating their needs for the months ahead. As soon as these reports are received the Department prepares state wide estimates and places orders immediately for at least 75 per cent of its winter requirements of rock salt. Deliveries are made as early as September, and by October the state is set for whatever winter storms come along. Because of such early ordering, division engineers can handle emergencies the moment they arise out of stock on hand, and motorists throughout the state get safe roads immediately after a storm, with no delays caused by lack of snow removal equipment and supplies.

In storing the salt, the state puts as much of it as possible indoors and the rest outside. Outside storage is a simple matter to arrange, for the salt is often just dumped on hard ground and covered with a tarpaulin, with very little loss from the weather. To supplement its indoor storage space, the state recently bought surplus 20 to 25-ton storage boxes from the government. These are mounted on skids so that trucks can easily pull them from one point to another. They are set up along the highway and used for intermediate storage points; trucks can fill up from them and eliminate the need for doubling back to a central storage plant.



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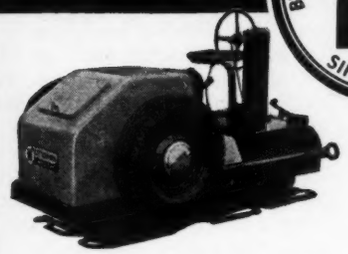

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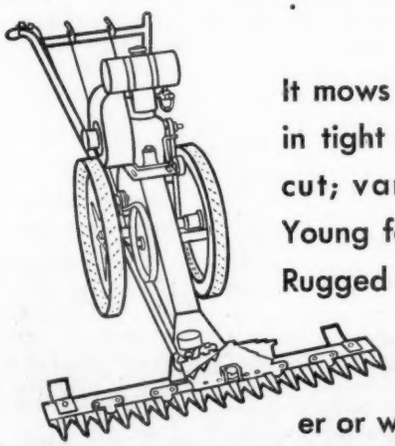

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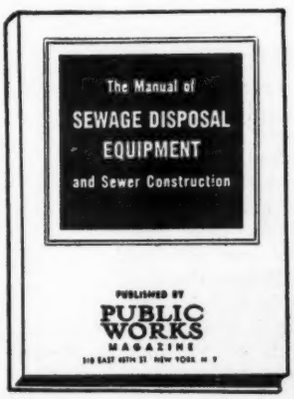

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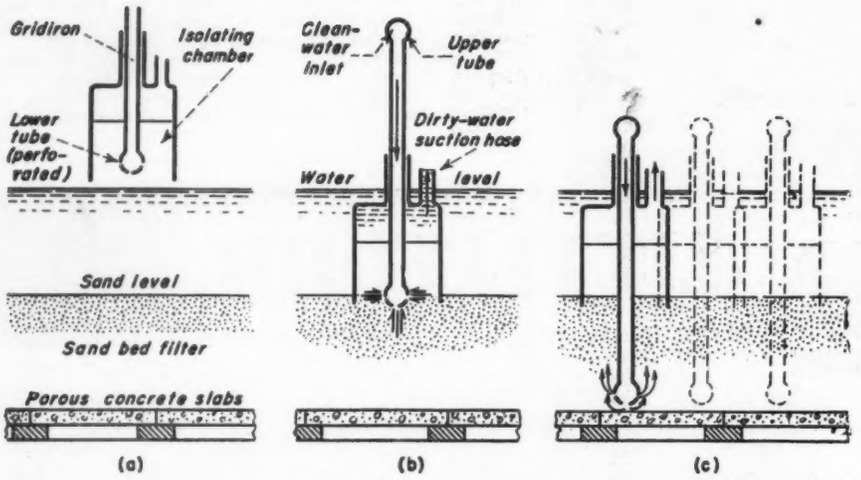


Courtesy Engineering News-Record

Steps in washing of slow sand filter with "selecteur" are: (a) the chamber and gridiron are lowered to sand surface; (b) gridiron washes its way down through the sand (c) until it reaches the filter bottom, when it is withdrawn and the entire apparatus moved to an adjacent strip.

French Water Treatment

Because of distrust of slow sand filtration and prejudice against coagulation in France, several methods of treatment have been adopted by different water companies. One company, which supplies water to the suburbs of Paris and of Lyons, to Nice and the French Riviera, uses two-stage slow sand filtration, followed by chlorination of the supply for the Paris suburbs and ozonization for that of Nice and the Riviera. For Paris suburbs the supply from the rivers Seine, Arne and Oise receives two stage filtration through open sand beds 3 ft. deep, copper sulphate and alum being added to the effluent of the primary filter (the former to prevent algae growth), and chlorine to the final effluent. The prefilters have an area of 5.78 acres, the final filters 18.3 acres. Filtration is at the rate of 26.7 mgad for the prefilters and 5.3 for the final filters; higher in summer. Grain size, 0.75 to 3.0 mm. The filters are cleaned by "Sivade selecteurs," which consist essentially of a truss framework spanning the filter bed and supporting a sheet-metal chamber and a gridiron of pipe. The framework is movable along the length of the filter bed by means of trucks at its ends rolling on rails set along the longer sides of the basins. The apparatus is rolled into position above the filled basin, and the chamber is lowered on the sand. Inside the zone or strip thus isolated, the sand is washed to its full depth by injection of clean water into the sand bed from the lower pipes of the gridiron. Dirty water from above the surface of the sand is removed by suction through another set of pipes. When one strip of sand has been completely washed, the gridiron and chamber are lifted and the machine moved to cover an adjacent zone or strip. The entire bed is cleaned in this manner.

The Sivade machine differs from the Blaisdell washer, used at a few plants in the United States, in that it does not cause any mixing of the sand by mechanical methods.

At the other plant the water, from mountain streams, is filtered at 8.56 mgad, then ozonized, power for the latter being supplied by hydro-electric plants operated by the water being treated.[E25]

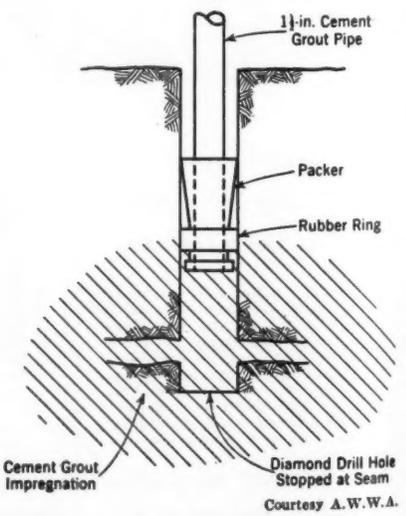
Cement Lining a Steel Pipe Line in Place

Los Angeles, Calif., recently lined 10,880 ft. of 31.4″ steel pipe in place, with ¼″ of cement mortar placed by a "Centriline" machine. This line, installed in 1935, had originally been coated with bituminous enamel. Since 1943, small flakes of enamel have been found in meter screens and relining seemed to be desirable. Before the line was relined, to remove bacterial slime on the pipe, chlorine was introduced at the upper end at the rate of 50 ppm and allowed to move down stream at the rate of 2 fps until concentration of 15 ppm appeared at the other end of the line. The line was then closed and the chlorinated water held in it overnight, when the line was emptied. Then access holes were cut 475 ft. apart to admit the lining machine, mortar and men. Men scraped off all loose enamel, tubercles, rust and slime and smoothed the edges of the enamel remaining. After this, any slime remaining was removed with kitchen scrubbing brushes and an air jet was used to remove dust and other small particles. A gang of 9 men cleaned from 475 to 1200 lin. ft. of pipe a day. During operations the pipe line was lighted and each man had a head-band type of flash light. Blowers dried the lining in advance of scraping and provided ventilation.

The mortar used for lining was proportioned 2 cement to 3 sand, with 2¾ gal. of water per sack of cement. Curing was effected by keeping the newly lined section closed off to the circulation of air, and the line was filled with water as soon as possible. Access holes were closed in advance of the lining machine by welding on plates. The Hazen-William C was 123 before chlorination, 129 after chlorination, and 143 after lining. Cost, $3.30 a foot, including flushing, draining, cleaning, drying and inspection as well as the placing of the lining by contract.[E26]

Grouting Dam Foundations

Rock on which dams are founded may be grouted either to prevent leaking through it, or to prevent settlement. Cement is commonly used (without



Courtesy A.W.W.A.

First increment, step grouting.

The blow of the hammer rings clear, indicating that the pipe has reached the trench side from the foundry with its rugged quality unimpaired. After this final precautionary test, each length of cast iron pipe is lowered into the earth to begin its century or more of reliable and tax-saving service. Throughout its production cast iron pipe is tested at every step, from raw materials to final inspection, by modern laboratory and production controls. All manufacturers guard to the utmost the quality reputation of a product known for longest life with lowest maintenance cost. Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 S. Michigan Ave., Chicago 3.

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sand) for either, asphalt has been used for the former. Grouting sand and gravel is sometimes possible, but if the material is fine, consolidation rather than grouting is effected. For some soils, bentonite, clays and other materials are more advantageous than cement.

In cement grouting in rock, the spacing of the grouting holes should be adapted to the rock. For bearing, holes are drilled by air tools, washed out, and a pipe nipple grouted into the top, and the hole grouted under low pressure to resistance. The hole is re-drilled deeper for leakage prevention by high-pressure grouting. Cement grout should be pumped by piston-type, slush-fitted pressure pumps which have removable cylinder liners and rubber pistons. Air-operated pumps are generally used to provide flexibility. Grout is started at 2 cu. ft. of water per sack of cement, and if it can not be grouted to refusal, the grout is thickened to 0.5 cu. ft. of water. No hole is considered to be throughly grouted until it refuses a mix of 1.6 consistency for a period of 1 to 2 hr. under a pressure of about 1 psi per ft. of depth.

Grouting may be either "stage" or "stepped." In the former, the packer (plug limiting the top of the grout) is set progressively from the bottom of the hole to the top in 10 to 20 ft. increments, each stage being grouted to refusal. In step grouting, a hole is drilled to the depth of the first increment.—probably a seam—which is grouted to refusal. Then the hole is reamed out and drilled to another seam and grouted; and this repeated to the desired depth.

Mixture of sand with the cement is not advised. But admixtures for hastening setting may be desirable. These include calcium chloride, sodium silicate, and "Lumnite."

In soil consolidation, a 2″ or 2½″ pipe is sunk, cleaned out, and raised about 2 ft., grout pumped to refusal; then the pipe is jacked up about 2 ft. and grouted, and this repeated. Close spacing of holes is necessary for maximum results. In extensive jobs it may be economical to mix with the cement 2 parts of clay which has been thoroughly dried and screened.

Asphalt is most effective in labyrinthal seams where effective stops against movement are available after it has frozen. Melting points should be about 185° to 190° F, and flashpoints 450° to 475°. The asphalt is generally heated to 400°-450° and pumped through 1½″ or 2″ pipe, with a ball valve piston-type pump.[A136]

Constructing Two Concrete Dams

The Saugatuck dam of Bridgeport, Conn., is 126 ft. high over all, 100 ft. thick at the base and 1100 ft. long. Gravel for the aggregates was secured 3 miles above and screened into 3 sizes. In each batch, 23% of the aggregate was 2″ to 6″ gravel, 18% was 1¼″ to 2½″ gravel, 30% was ¼″ to 1¼″ gravel, and 29% was sand. The concrete was mixed very dry with a ½″ slump. In the interior, 0.93 of a barrel of cement was used, and 1.07 near the face. Concrete was delivered from mixer to dam by a Lidgerwood cableway with a 15-ton capacity. Low-heat cement (SSP 206) was used, and a water-cement ratio of 0.54; and the concrete had an average compressive strength of 4,600 at 28 days and 5,700 in a year. Because of the small slump, vibrators were attached to the 4-yd. buckets, and 90 lb. pneumatic vibrators were used to consolidate the concrete in the forms in 15″ layers. The blocks averaged 4 ft. high and 40 ft. long by the full width of the dam. Three days elapsed between lifts. Earth was filled against the downstream face of the dam to within 45 ft. of spillway level to protect the concrete from freezing and spalling. The total cost of 79,000 cu. yd. of concrete averaged $6.25 per cu. yd. including erecting and dismantling all plants and buildings, forms, water supply and all equipment less the price for which it was sold.[B25]

Norwalk Lake dam, Norwalk, Conn., is 105 ft. high, 77 ft. wide at the base and 1012 ft. long. In preparing plans, core borings were made at 75 ft. intervals on three lines, one the center line, the other lines 75 ft. upstream and downstream respectively. Test pits were dug to bed rock, 10 to 25 ft. deep.

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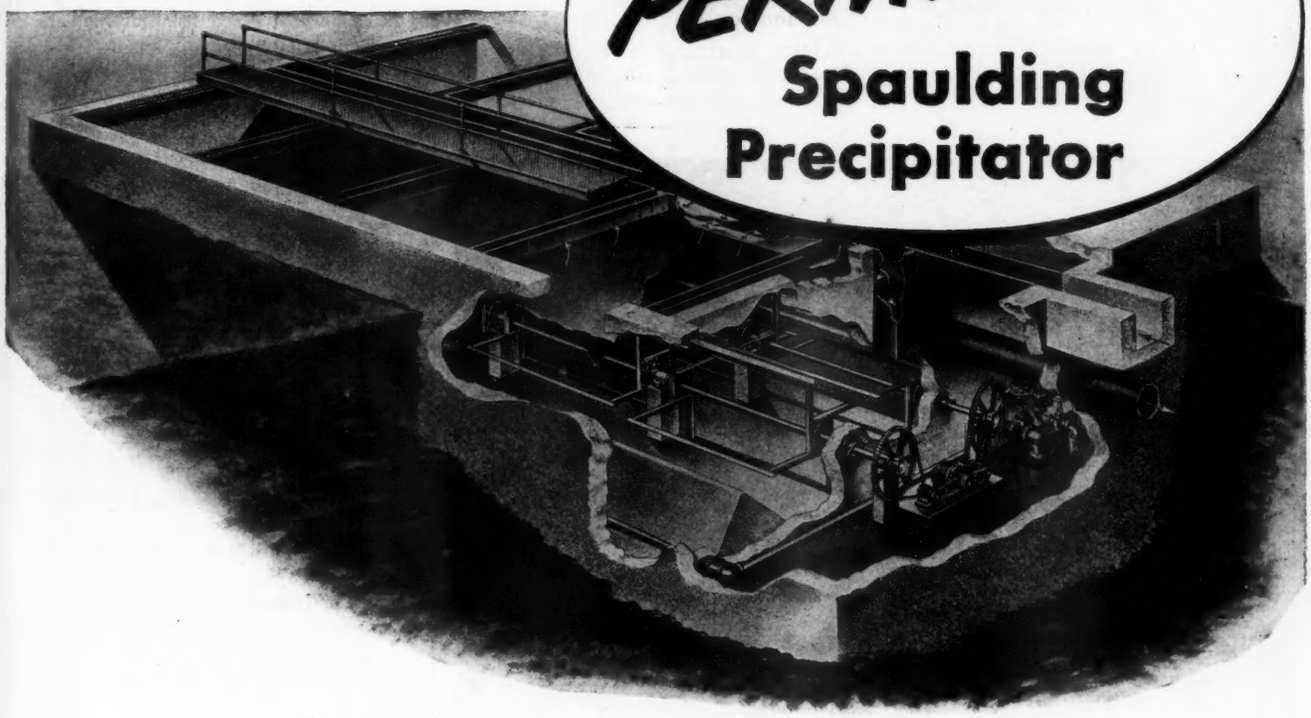
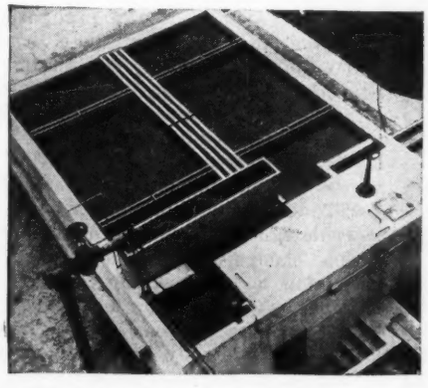


Cuts detention time, saves chemicals, takes only 1/2 the space of former methods



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Gravel was obtained 1800 ft. above the dam, crushed in three sizes—¼" to 1¼", 1½" to 3", and 3" to 6". The concrete constituents for a 4 cu. yd. batch were placed in transit-mix drum-type trucks at the gravel plant and mixed during the 3-minute run to the dam. The mix used was 1.11 bbls. of cement per cu. yd.; water, 6.5 gal.; water-cement ratio 0.57; slump 1.5 in. The 28-day strength averaged 3500 lb. Concrete in the forms was vibrated with heavy-type electrically driven vibrators. It was placed in 5 ft. lifts in alternate blocks of 50 ft., with an interval of 21 days before adjoining blocks were poured and a 5 day interval between successive lifts; the intervals being to allow cooling. Water stops of 3/16" x 8" wrought iron were used in keyways in horizontal joints; and 6" x 12" open vertical drains were placed in each 50 ft. vertical joint near the upstream face and connected to a gravel-filled drainage tunnel on bed rock the full length of the dam and discharging below the dam. Total concrete, 74,000 cu. yd. Total contract cost $937,240.[B24]

Break-Point Chlorination

After treatment with chlorine, the odor often remains in water after the taste has disappeared, but disappears quickly when the water is drawn from a tap. While break-point chlorination is being established, a band fans outward in which chloramines are formed between the chlorine and organic matter in the mains. In Stamford, Conn., it took a year for this to travel 6 miles, while free chlorine varied from 75 to 100%. Meantime there were complaints of abnormal tastes and odors in this band and organisms of the coliform group were found in samples from it. In at least one instance in Connecticut, break-point treatment eliminated tastes and odors from algae.

No general rule for establishing rate of dosage is available, and for this the jar test or the "Laux" flash point test is used. Time of contact is important; in several instances improvement in taste and odor have been found 4 or 5 miles from the point of chlorine application while at half that distance abnormal tastes and odors were found. High chlorine residuals from break-point chlorination would be less affected by sudden increases in chlorine demand (such as from algal growths in a reservoir) than would be the case with normal chlorination. At one or two Connecticut plants, pre-chlorination to break-point has been used and a good residual carried through the filters, aiding floc formation and giving a cleaner filter.[B26]

Laying a Subaqueous Main

In laying a 42" Lock Joint reinforced steel-cylinder concrete pipe line in Puerto Rico, in water 10 ft. deep with 3 to 5 ft. of muck in the bottom on top of stiff clay, a trench was excavated in the clay and leveled to grade with crushed stone. In laying the pipe on this, the contractor built a pile bent trestle on the line. The pipe was assembled just under water and supported by U-bolts hung from the bents. A steel cable inside the pipe was attached to caps on both ends and brought under tension to assure that there would be no undue stress on the jointing lugs during the lowering process.

A sheave was mounted on the trestle above each length of pipe and a steel cable, attached to a sling on the pipe, was carried up and over each sheave. These, in turn, were clamped to a main cable which ran the length of the trestle. The clamps were adjusted to give equal tension on all lowering lines, and the pipe was dewatered. Then the U-bolt hangers were removed and the pipe was lowered uniformly throughout by slacking off on the main cable.[L11]

Activated Silica In Water Purification

Activated silica can benefit floc formation in nearly all water supplies, the methods are not too complicated for use by operators, and there is a reduction rather than an increase in the silica content of the finished water when used with alum. As to cost, this may be decreased by use of less, or less expensive,

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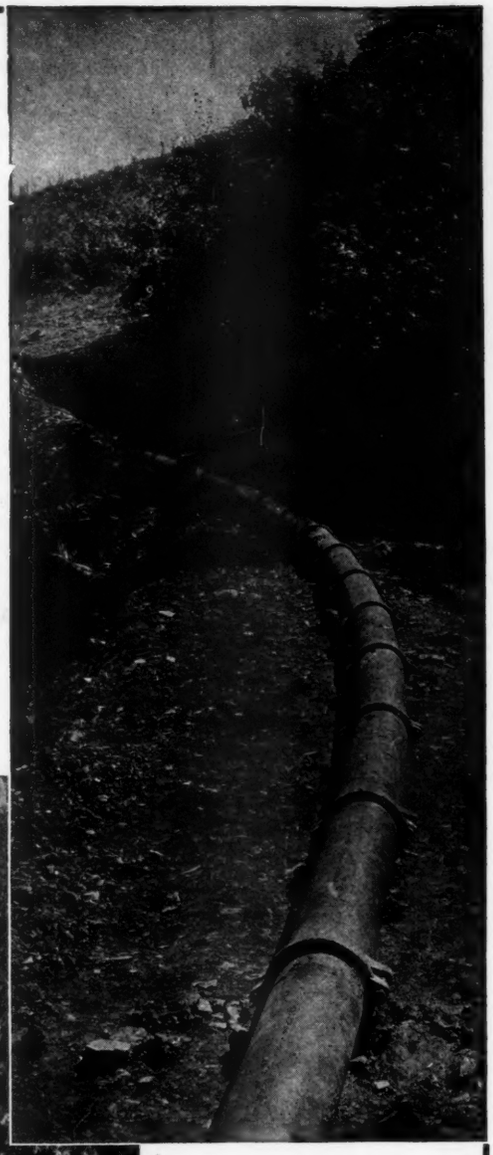

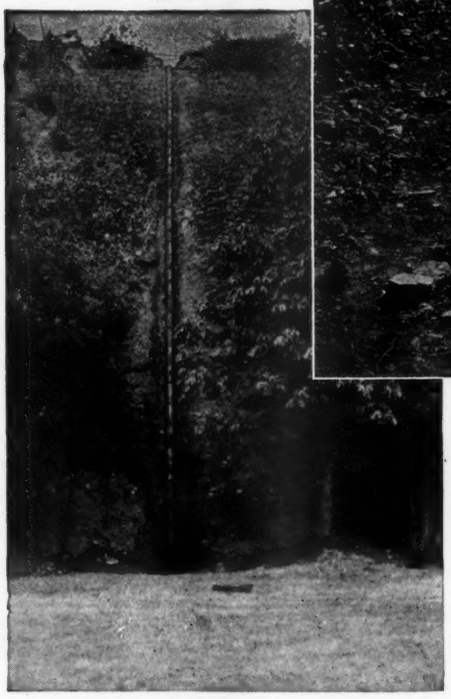

Above *All straight lengths of Universal pipe in this curve.*

At left *16" pipe laid on a 45-degree slope. Note deflection at top to level ground without fittings.*

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coagulant, elimination of soda ash or lime as a pH correcting agent, and usually lower wash-water consumption, soap savings, and decreased fixed charges when plant operation at a higher rate of flow is made possible.

The coagulant and the silica should be added separately, with rapid and complete distribution of each. In some cases silica should be added before alum or lime, in other cases after it. The silica does not produce floc by itself and therefore its detention period has little significance, but thorough mixing is important. Silica-alum floc is strong and is improved by high-velocity conditioning by mechanical agitation. Properly prepared floc forms and settles in about one-third the time necessary when silica is not used. In most cases 10-20 min. of conditioning is ample with velocities 50% to 100% greater than customary. Because the floc is heavier, higher velocity is necessary to prevent settling in mixing basin or flumes. Baylis believes that by using silica, settling time and filtration area can safely be reduced 25%. The use of silica has caused clogging of filters using 0.35 to 0.45 mm. sand, but this ceased when this sand was replaced with 0.7 to 0.75 anthrafilt.

The ratio of coagulant to coagulant aid is important, and it may be necessary to change it from time to time as the character of the water changes. With a heavier, stronger floc it is natural that higher rates of back-wash or surface washing or some other means of breaking up the floc should be required.[G44 & 49]

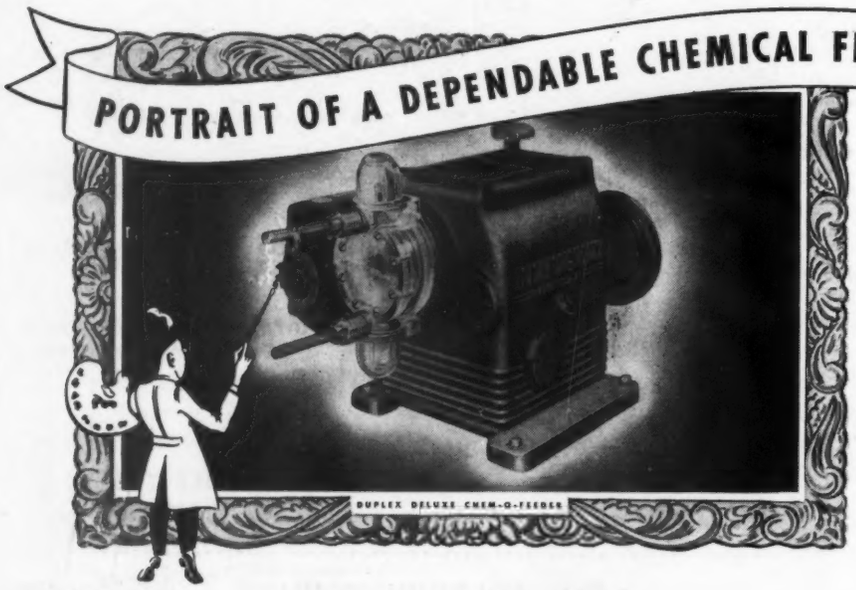
Synthetic Resins As Organic Finishes

To function as organic finishes, resins are dissolved in a solvent or blend of solvents, with certain modifying resins and plasticizers added to give desired results. The variety of combinations is almost limitless. The more important are: Nitro cullulose, produced by treating cotton linters with mixtures of nitric and sulphuric acids; dries extremely fast; used in producing organic finishes that are tough, durable and resistant to many dilute acids and alkalies. Cellulose acetoesters, produced by treating wood or vegetable fibres with acetic acid and anhydride; do not adhere well to metal. Ethyl Cellulose, manufactured from cellulose, caustic soda and ethyl chloride; chiefly used as a modifying agent in varnishes and lacquers. Vinyl Resins, made from petroleum or coal; extremely inert at ordinary temperatures; resistant to practically all acids, alkalies, oxidizing agents, gasoline, grease, alcohol and water; widely used for protecting concrete and other alkaline surfaces and for protection against chemical fumes. Acrylic Resins, derived from petroleum or coal; chiefly valuable as color modifying agents with lacquers. Polystyrene Resins, derived from petroleum or coal; fail in adhesion and flexibility. Vinylidene Resins, from petroleum or coal and salt; excellent resistance to most substances but lack in adhesion and stability. Alkyd Resins, derived from coal or grain and vegetable oils; give a glossy film, good adhesion, long life and resistance to weather, grease and chemicals. Urea Resins, from coal; in combination with alkyds adhere to metal; good resistance to oils, greases and waxes and fair resistance to weak acids and alkalies. Phenolic Resins, from a distillate of hard wood or petroleum; the oil-soluble thermoplastics have excellent resistance to outdoor exposure. Melamine Resins, compounded from coal and lime; excellent resistance to outdoor exposure, and abrasion, with exceptional color retention.

Many synthetic resins have desirable properties in common; many have individual characteristics that recommend them for particular purposes; by a skillful compounding of resins, plasticizers, solvents and inhibitors, other advantages can often be developed.[B22]

Experimental Filters at Finham

At the Finham disposal works of Coventry, England, operation began in May, 1946 with an experimental plant consisting of four circular filters and four humus tanks. Filter No. 1 is treating settled sewage at an average rate of 60 gal. per cu. yd. per day by single filtration; Filter No. 2 at an average



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SPECIFICATION:

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0 to 11.0 cc (at 100 psi)
Stroking Rates — 12, 26, 48 per minute
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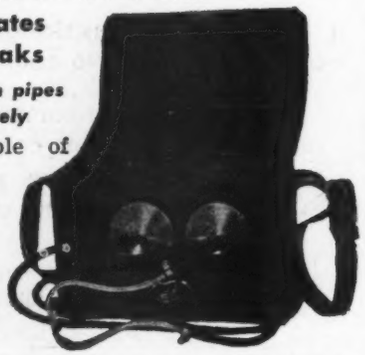

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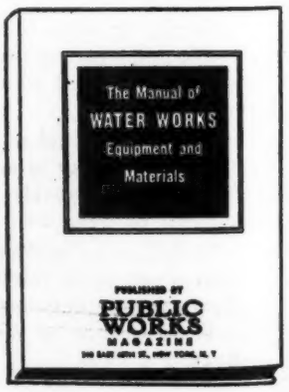

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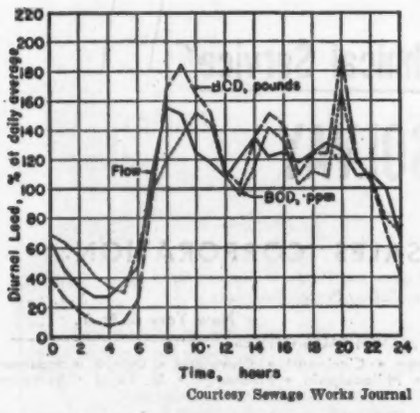
The Sewerage Digest

Sewage Treatment at Military Installations

There has just been made public a report, occupying 238 pages of Sewage Works Journal, prepared by the Subcommittee on Sewage Treatment of the Committee on Sanitary Engineering, National Research Council, which is, as the editor of that Journal says, "probably the most comprehensive analysis of mass sewage works operation data that has ever been atempted." Of several hundred treatment plants at military installations in 1944, about 50 more studied by the committee to serve as a basis of this report, the selection being based largely upon the completeness and reliability of the laboratory analyses of plant operation which were kept. The plants studied include primary treatment, 7 plants; trickling filters, 34 plants; activated sludge, 5 plants; contact aeration, 6 plants; oxidation ponds, 1.

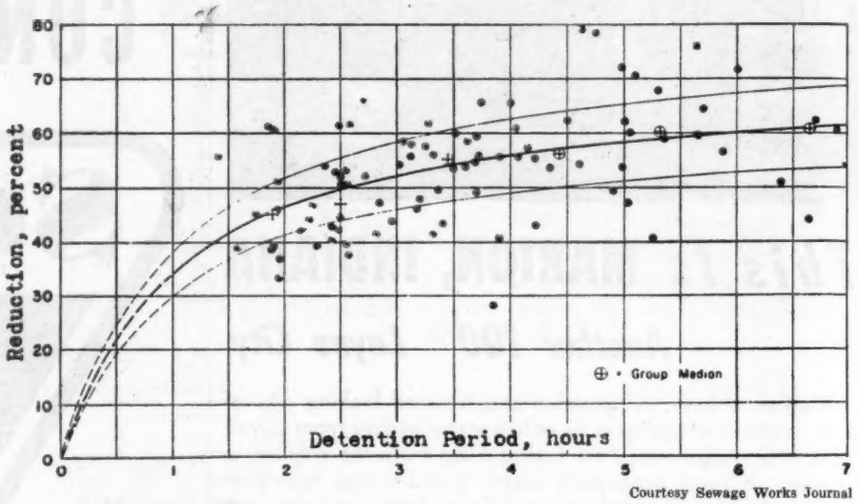
The report contains voluminous data, in the form of tables and diagrams, for each plant; and discussions of their significance and general applicability. As to the latter, attention is called to the difference of conditions at the military installations from those at most municipal plants. However, practically every finding in the study is adaptable to municipal sewage works practice if proper adjustment is made for the difference in sewage characteristics and flow rates, and for the divers industrial wastes which are found in most municipal sewages.

It is impractical to give, in digest form, any idea of the data included in this report; but an effort has been made to give, in the following items, digest of the more important conclusions derived therefrom.[C52]



Courtesy Sewage Works Journal

Typical hourly variation in flow and BOD.



Courtesy Sewage Works Journal

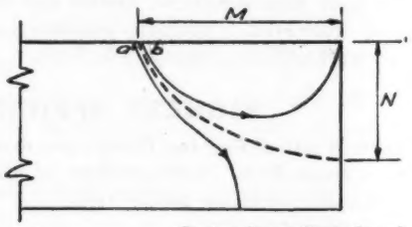
Suspended solids reduction in primary settling tanks without recirculation.

Characteristics Of Military Sewage

Military sewage normally arrived at treatment plants in a fresh and uncomminuted condition, with slight odor. Oxygen content was normally low, usually zero during moderate or peak flows. Compared to municipal sewage, it was more concentrated, had a greater proportion of volatile matter relative to the total solids, contained a higher proportion of grease, and exhibited larger and more rapid variations in diurnal flow. In five plants the night minimum fell to less than 30% of the daily average, and in eleven the morning peak exceeded 160% of that average. The BOD varied even more from hour to hour—from about 20 ppm at night to 160-200 ppm at 8 A.M. and 8 P.M. in several plants. A composite record shows one-quarter of the total BOD load (in pounds) arriving in only 3 or 4 hours, and three-quarters in 11 to 13 hr. At small plants 10% of the total daily load of BOD arrived in 1.3 hr. or less.[C53]

Settling Tank Performance

Detention period was made the primary criterion of design for settling tanks at military installations. Data collected by the Committee of Sanitary Engineering seemed to confirm the belief that "surface settling rate was inferior to detention period as a measure of performance in settling tanks at military plants." However, "this might not have been the case if flows per unit volume of tank had been larger." The design period for these tanks was 1.5 hours for activated sludge primary tanks and 2.5 hours for all others. The actual detention periods (average for 24 hr.) varied from 1.38 to 5.38, 13 of the 17 plants being above 2.5. But



Courtesy Sewage Works Journal

Critical locus at effluent weir.

owing to the great variations of flow in the plants, the detention periods at maximum flow ranged from 0.98 hr. to 2.92, and at minimum flow from 2.06 to 27.20. Analysis of the figures indicated that, as in municipal plants, there was little improvement in BOD removal with detention periods longer than 3 hr., but there was some increase in suspended solids removal.

The BOD removal in these plants was distinctly inferior to that usual in municipal practice. While the average BOD removal in 26 municipal plants has been found by Keefer to be 35.1%, in these

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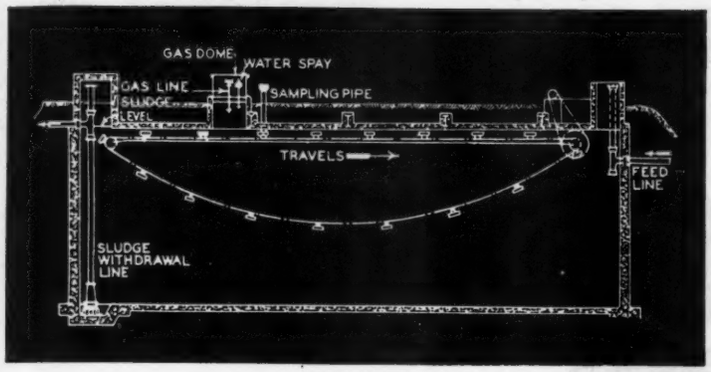

Link-Belt Straightline Scum Breakers are used in either round or rectangular digestion tanks to break up the floating scum, paddle it down and submerge it. Essential parts of the installation are shown diagrammatically at left. Tank is shown in longitudinal section. The scum breaker consists of two strands of chain with pitched flights between them, traveling at a slow speed.

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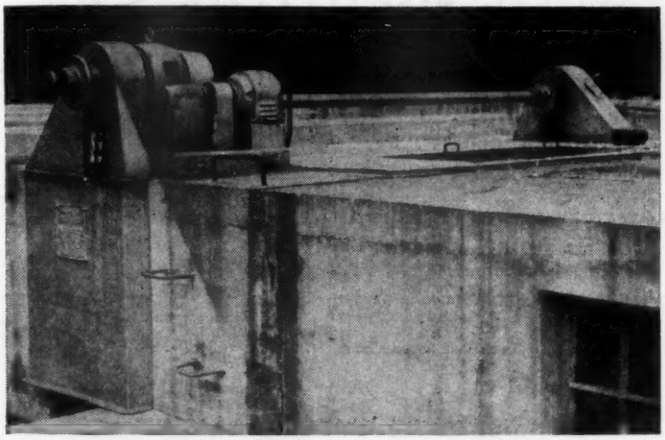

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plants the average was only 28.5%. This was believed due, not to too long detention in the military plants, but to the greater non-uniformity of flow. This idea was studied exhaustively and the report develops principles and formulas which it explains in detail. "Consider the region in a rectilinear tank in the vicinity of the effluent weir, which is located at the end of the tank (see illustration). With a fixed rate of flow per unit length of weir q, and with particles of constant settling velocity v, there exists a critical point on the water surface a distance M from the weir." A particle with the settling velocity v, released at a distance slightly greater than M, will describe, under the combined influence of gravity and tank flow, a path indicated by the curve in the illustration. But any particle released nearer the weir will be carried over the weir. If the tank flow increases, M also increases in length. The area of the tank above this curve is called the "ineffective zone" for particles with this settling velocity. Formulas were developed to show that this ineffective zone is a quadratic function of the ratio of the flow intensity and the settling velocity. If the flow per unit length of weir is doubled, then the ineffective volume for particles of a particular size is quadrupled. This ineffective volume may constitute a substantial proportion of the total tank volume. It was further calculated that if the flow ranges from 25% to 175% of the daily average, the ineffective volume will be 28% larger than for uniform flow.[C55]

Screens and Grit Chambers

All the military installations were equipped with either coarse screens or comminutors, most of them with both, the screens to serve when the comminutors were out of commission—which was very seldom. "The satisfaction of the operator with this equipment was nearly universal."

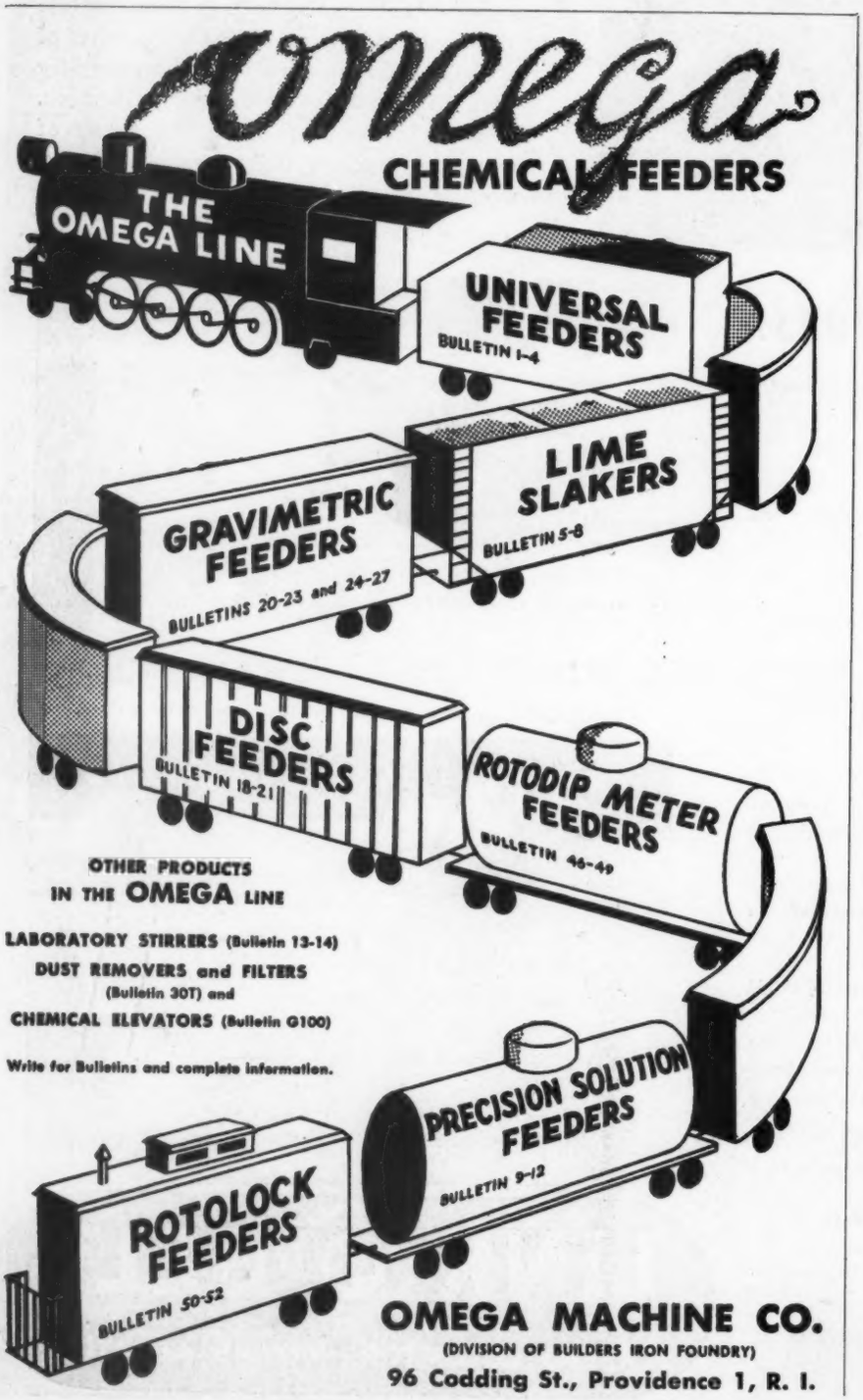
At a number of posts, grit chambers were installed after the treatment plant had been in operation, especially in old cantonments using old sewers from World War I days. The rectangular grit chamber with velocity of about 1 fps was the design generally favored, using Sutro weirs, Parshall flumes and Palmer-Bowlus flumes for velocity control. In several plants considerable grit was found in effluents from sprinkling filters because of insufficient screening of the filter stone before placing it.[C54]

Trickling Filters At Military Posts

More than one half of the treatment plants at Military posts included trickling filters, and 34 of the 300 were selected for complete study. With every type installed there were instances of both notable performance and substandard. The filters were classified in three ways: Those with depth of media greater or less than 4.5 ft.; those with recirculation ratios greater or less than 100%; and whether single stage or multi-stage. There were 10 deep filters without recirculation; 6 deep filters with low-ratio recirculation and 5 with high-ratio; 1 shallow filter with low-ratio recirculation and 7 with high ratio; and 9 with two-stage filters. (Four of the plants contained two types.) The data for each of the plants are presented in detail and discussed, this part of the report occupying 86 pages.

It was found difficult to establish the relationship between loading and performance, due to the many variables involved, especially where recirculation is practiced. The committee concluded that "the simplest and most direct measure of filter loading is the average weight of BOD in the settled sewage applied to the filter per day. This does not include recirculated BOD," but this has a "treatability" essentially different from the BOD in raw settled sewage.

The amount of biologically active growth in a given filter is dependent primarily upon the surface area of the contact media, not directly but proportional to the diameter of the media raised to an exponent between 1 and 2. Also the important thing is the volume of *active* growth. Moreover, the extent to which the space available will be occupied depends upon the rate of application of the load, which furnishes the food for the organisms. But while high loadings and recirculated flows favor



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this growth, high rates of dosage increase the scouring action, which tends to limit the amount of growth. The data from these plants are used for discussing the effect of recirculation on performance, the types of recirculation, relation between recirculation ratio and number of passes through the filter, efficiency of second-stage filters, and optimum relative size of filters in series.[C56]

Contact Aeration

Contact aeration plants were constructed at about 50 Army installations and at numerous Navy ones. They included primary settling tanks; primary aeration units, in which vertical asbestos plates are supported above horizontal pipe-grid aerators; intermediate settling tanks; secondary aeration units; and final settling tanks. "Under favorable conditions of loading and sewage concentration, good effluents were obtained, with over-all removals of BOD averaging 80 to 95% in the plants selected for study. When strong stale sewage had to be treated, however, or when difficulties developed in the aeration system originally installed, effluents were unsatisfactory, odors became intense, and first-aid measures had to be applied in order to keep the plants in service."

"No significant difference existed between the kind of organic material entering the second stage and the first" which is "at variance with the concept of this type of plant as a 'condensed stream' where self-purification is carried forward by a succession of different organisms, each utilizing the waste products of the preceding species."

"The difficulties of operation of contact aerators—high maintenance labor requirements and more than occasional odor nuisances—indicate that contact aerators are less desirable for use in military camps than are trickling filters. No superiority of contact aeration over activated sludge treatment has ever been demonstrated."[C57]

Activated Sludge At Military Camps

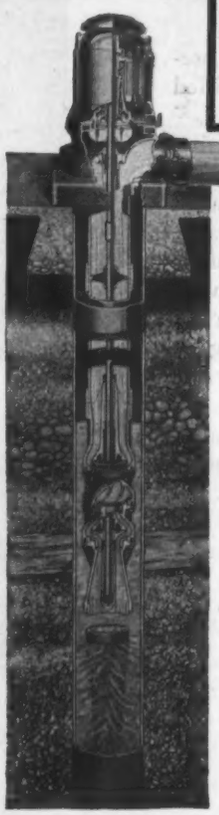
Five activated sludge plants were studied. The average BOD of the raw sewage ranged from 224 ppm to 397 ppm, which was reduced by primary settling to 175-284 ppm, and by the aeration basin and secondary settling to 13-63 ppm. The tests used in the control of plant operation were: On the mixed liquor—(1) dissolved oxygen; (2) suspended solids; (3) sludge volume, and (4) sludge index. On the return sludge—(1) suspended solids, (2) sludge volume. Unfortunately, the percentage of ash in the mixed liquor solids was not determined regularly.

All the plants produced bulking sludge (sludge index of 150 or over) during a considerable portion of the time. The reason for it was not certain and may have been different at different plants. It apparently was not due to long primary detention periods. Possible factors were: (1) Irregular distribution of flow; (2) excessive grease content; (3) high BOD values and rates of biochemical oxidation; and (4) high volatile content. It was thought that the load should be kept under 0.2 lb. of BOD per pound of suspended solids in the aeration and secondary settling tanks. Also, that sludges with ash content of 20% or more are not as likely to give trouble as those of lower ash content.

"As designed at present, activated sludge plants are not sufficiently flexible to handle the variations in flow and load that are to be expected in military posts. With the best available control and operation, very light sludge indices (over 200) were obtained during the greater part of the time."[C58]

Sludge Digestion At Military Plants

The design figures for sludge digester volume were 3.0 cu. ft. per cap. for trickling filter plants, 4.0 for activated sludge and 2.0 for primary treatment plants; with 50% added for unheated tanks. Seven of the 8 plants studied used two-stage digestion. Secondary digesters were generally unheated. Temperatures in heated tanks ranged from 90° to 98°. Mean gas production was 1.25 cu. ft. per cap. daily, or 13.9 cu.



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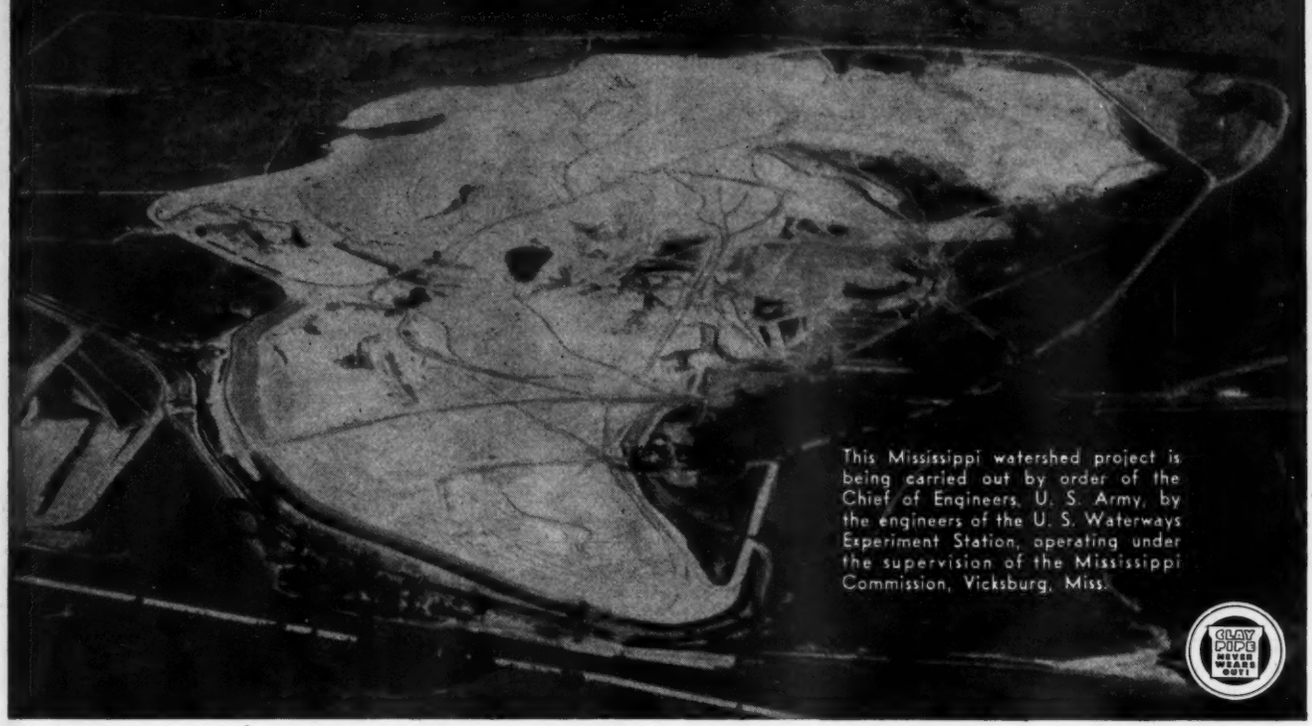
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ft. per lb. of volatile matter added and 20.5 cu. ft. per lb. of volatile matter destroyed. The average destruction of solids added to the digesters was 69.0% of the volatile solids and 57.1 of the total solids.[C59]

Oxidation Ponds At Military Plants

Oxidation ponds were used for secondary treatment at a number of military installations. These consisted of a series of large open basins 2 to 3 ft. deep, which received settled raw sewage. Capacities ranged from 400 to 700 persons per acre; detention periods from 20 to 30 days. The efficiency of the ponds was 43% for suspended solids and 76% for BOD. They had a remarkable ability to remove coliform organisms; individual samples very often would show no positive presumptive tubes in 10 ml portions.[C60]

Clarification and Biological Oxidation

Whether chemical or biological processes be employed for clarifying sewage, fundamentally the same work must be performed to bring about the desired results. The failure of chemical treatment to attain optimum results is due largely to adversely high pH-alkalinity values in the saw sewage, and successful and economical coagulation may be ensured by initial downward adjustment of the pH-alkalinity value, using various means such as precarbonation, or dilution by treated water having lower pH-alkalinity value, or both, *before* introduction of the coagulant. Likewise, biological processes are adversely affected by high pH-alkalinity values and, in extreme cases, may be a complete failure since the biological environmental requirements are also involved.

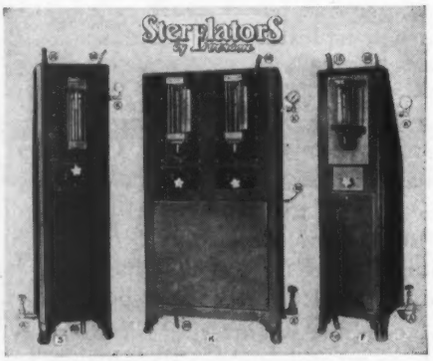
All biological oxidation processes are basically similar, despite the physical dissimilarity of the various types of plants. Difficulties in correlating the work accomplished by similar plants under comparable loading conditions can be ascribed in a large measure to a disregard of the respective pH-alkalinity values. Plants designed solely on a B. O. D. basis do not necessarily produce the anticipated results, but this may be determined by the pH-alkalinity value in the public water supply and sewage.

In the operation of both chemical-biological and straight biological plants, adjustment of certain controllable factors such as pH-alkalinity value, dissolved oxygen, food and elemental ratios may substantially improve plant performance. Existing biological oxidation plants whose effluent quality does not come up to the required standard may require the adjustment of one or more of the factors involved. Adequate preconditioning of the sewage before passage to the oxidation process will often enhance performance and make possible the production of an effluent of low turbity and B. O. D. and of high stability.[C43]

Lagooning Sewage Sludge

Indianapolis, Ind., has used sludge lagoons for 20 years without creating nuisance, and believes that a mixture of primary sludge, activated sludge, plain aeration sludge and garbage can be digested satisfactorily without odors in open lagoons. If the lagoons are used for digestion only, at least 6 lb. of solids can be digested per year per cu. ft. of lagoon capacity. If the lagoons are used for digestion and also as dewatering beds, a capacity of 0.37 to 0.40 cu. ft. per pound of raw solids per year is sufficient, provided the air-dried sludge is removed as rapidly as it is ready for hauling. Using the above capacities, it is possible to discharge a supernatant of good quality to the receiving stream.

In constructing its lagoons, Indianapolis removes the top soil and uses it for embankment around the lagoon; also removing stumps and leveling the bottom to facilitate removal of the digested sludge. A ramp is built into each lagoon for use by trucks in removing the sludge. Sludge is brought from the plant in 12″ steel pipes and distributed in 8″ and 10″ steel pipes leading to each of the four corners of each lagoon



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and extending into the lagoon 20″ beyond the bank. Stoppages in the pipes, which are infrequent, are removed by blowing air through them. The supernatant from several lagoons is led to one containing practically no sludge, and the overflow from this is satisfactory for discharge into the stream. In starting a lagoon it is first filled to a depth of 3 ft. or 4 ft. with supernatant or digested sludge for seeding. If a filled lagoon is allowed to stand for 18 months and the free water collecting at low points be removed at intervals with a portable pump, the sludge attains a moisture content as low as 75%.[G24]

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49. National Round-up of Pollution Abatement Progress. Pp. 518-529, 550.
50. Pennsylvania Outlaws Pollution. By H. E. Moses. P. 530.
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12. Dewatering of Sewage Sludge by Coagulation and Vacuum Filtration at Manchester, England. Pp. 177-179.

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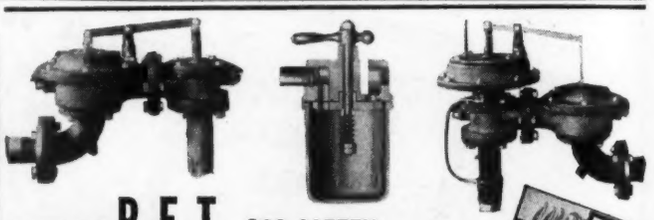

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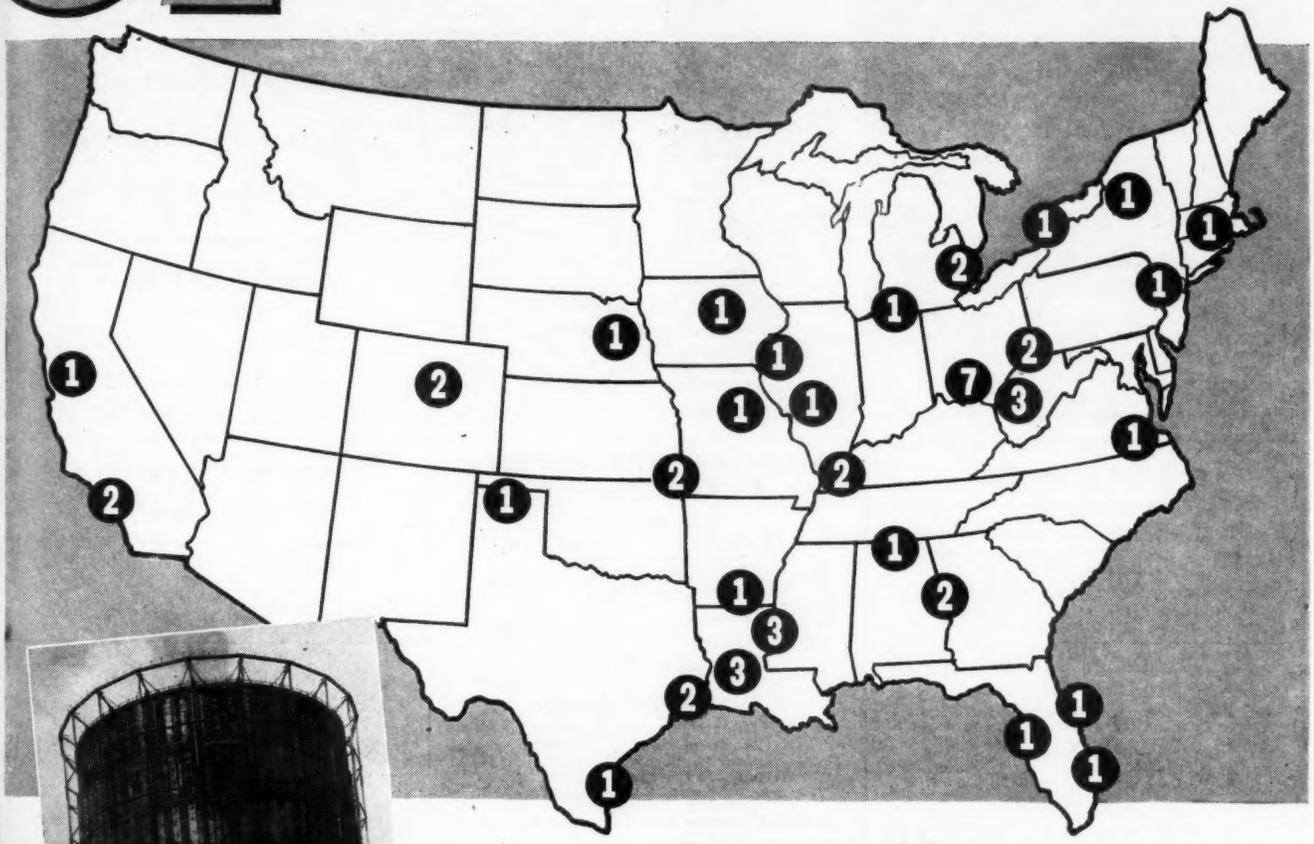

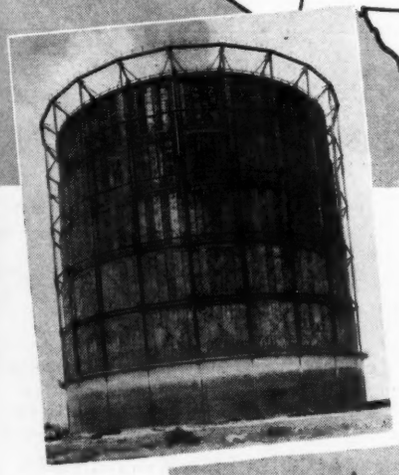

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Water Supply and Booster Systems for Building.—Complete data on head, capacity requirements, selection of proper system, pumping equipment, piping and pump layouts and approximate dimensions, 16 pages. Ask for Bull. 1500. Yeomans Bros. Co., 1425 No. Dayton St., Chicago 22, Ill.

Concrete Maintenance.—Practical information on bridge maintenance, increasing the useful life of floors, controlling shrinkage in machinery grouts, building restoration, repairing hydraulic structures, waterproofing grain elevators and sewage treatment plants, protective sealing, and decorating concrete and masonry surfaces. Ask for The Trowel, Vol. 1, No. 9. Master Builders Co., Cleveland 3, Ohio.

Multi-Stage, High-Pressure, Centrifugal Pumps.—These pumps, described in Catalog C-945 of Economy Pumps, Hamilton, O., are designed for capacities of 75 to 400 gpm. and pressures of 75 to 500 psi. Contains pump selection tables.

The Break-Point Process, an up-to-date publication of Wallace & Tiernan Co., Newark, N. J., is devoted mainly to the various tests used in the practice and control of break-point chlorination. 25 pages, mimeographed. Excellent for in-service, on-the-job training and instruction.

Perforated Metals and Screens.—It is impossible to do justice here to the contents of this 128-page bulletin. It contains just about all the information you can ask for on the subject and, in addition, a large amount of engineering data, tables, information for reference, etc. Perhaps the best summary is: "What do you want to know; here it is." Hendricks Mfg. Co., Carbondale, Pa.

Drinking Water from Brackish Water.—This is an 8-page booklet describing an ion-exchange unit for producing a soft and palatable water from almost any inland source. Schematic drawings and flow diagrams. Shows standard units available. Ion Exchange Products Dept., American Cyanimid Co., 30 Rockefeller Plaza, New York 20, N. Y.

Vertical Centrifugal Pumps—6-page bulletin describes three types of Peerless vertical centrifugal pumps for such purposes as sump and drainage pumping, general water supply, etc. Capacities range from 200 to 5000 gpm. against heads of 20 to 100 ft. Peerless Pump Division, 301 West Ave. 26, Los Angeles 31, Calif.

Earthmoving Equipment.—The basic zones recognized in modern earthmoving problems are defined and the types of equipment suitable for each are discussed. Delineation of the zones in which power equipment, slow speed hauling equipment and high speed equipment are used for maximum productivity is the subject of "The 1-2-3 of Zoned Equipment." Caterpillar Tractor Co., Peoria 8, Ill.

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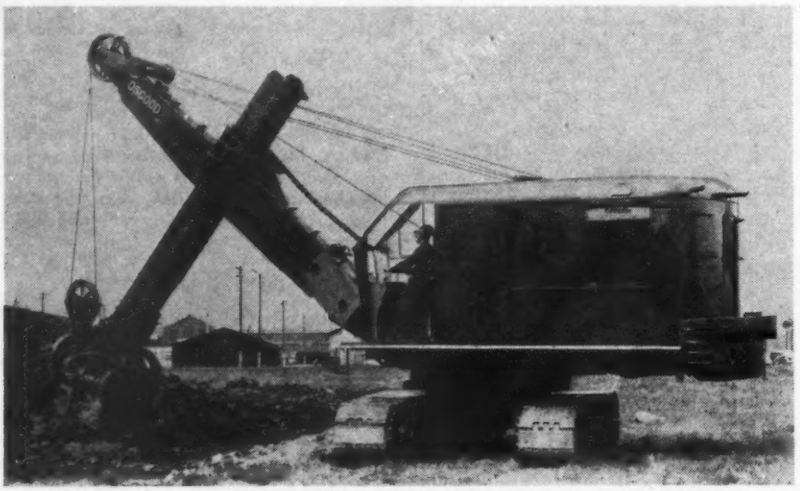
PUBLIC WORKS Equipment News

Osgood Medium Shovel of Modern Design

The Type 81 is a modern shovel, dragline, clamshell, crane and backhoe, which is made in three crawler-mounted models and a "Mobilcrane" self-propelled unit. The crawler mounted units are 1½-yard machine, a 1¾-yard machine, and a wide treat unit. All of these units are equipped with the Osfuller information ask for Bull. 804, The Hayward Co., 50 Church St., N. Y.



New Osgood Power Shovel.

good type of air control. The Mobilcrane has 12 wheels, standard, with speeds up to 5 mph. The many interesting technical details of all of the Type 81 models can be obtained from the Osgood Co., Marion, Ohio. *(Add to Chap. 1, Highway Manual.)*

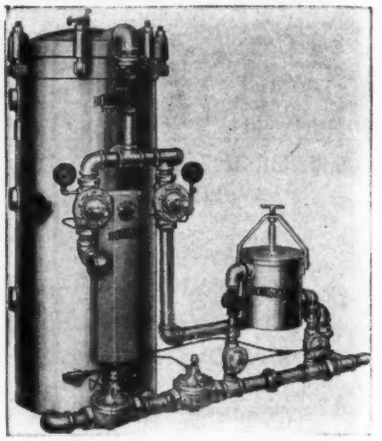
"Dwarf" Orange Peel Buckets Have Many Uses

For any job where material must be handled in close or cramped quarters, these small buckets are excellent and economical. They are available in five sizes, the smallest 100 cu. ins.; the largest 1 cubic foot. They are used for sinking cylinders and pipes for foundation and bridge work; digging wells; cleaning out old wells; cleaning manholes; sinking test pits and shafts; and many similar jobs. The smallest bucket, 100-inch capacity, will work inside a 12-inch pipe, and will operate to a depth of 75 feet or more. A hammer weight is attached for handling sticky or hard material. This drives the blades deeper into the material. The smaller buckets may be operated by a hand winch, which is available from the bucket manufacturer, but better results are obtained with power apparatus. For

Diatomite Filters for Water Treatment

A new series of water filters for swimming pools and industrial water filtration is being produced by Bowser, Inc., Fort Wayne, Indiana. The 611 Series, Bowser filters range in capacity from 15 to 500 Gpm with 7 to 248 square feet of filtering area to serve all sizes of swimming pools and most industrial requirements. These filters occupy only 1/20th the space needed for conventional sand filters. Filters are periodically backwashed and no manual cleaning operations are required.

Filter elements are tubular, plastic impregnated cartridges which support

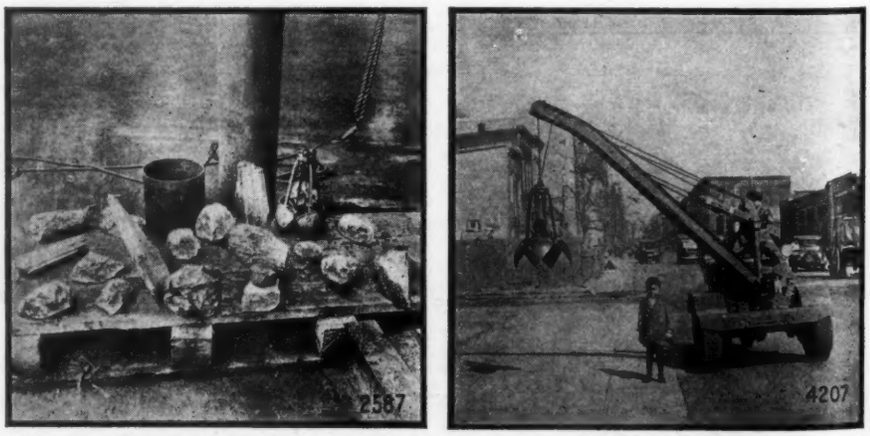


Bowser diatomite filter.

the filtering medium. Diatomaceous earth is deposited evenly on these cartridges. Filtration removes particles as small as ½ micron (approx. .00002), including all dirt, oils and other foreign matter to produce filtered water of unusual clarity. *(Add to Chap. 5, Water Manual.)*

Komline-Sanderson Sludge Driers and Furnaces

The Komline-Sanderson Engineering Corporation, Ridgewood, N. J., has been formed for the purpose of developing and marketing machinery and equipment for the treatment of sewage and industrial wastes. Partners in the concern are Thomas R. Komline and Walter H. Sanderson, both recently released from the Army. For eight years prior to the war, Mr. Komline was engaged in the development of the sludge drier and other equipment at the Plainfield, New Jersey, plant. Mr. Sanderson has



The small Hayward bucket can clean pipe and the larger buckets have many uses.

been active in the heavy construction field for over fifteen years.

Arrangements have been made with the Instant Drying Corporation for use of the basic patent on the spray-drying of sewage sludge, and this has been combined with the work of John R. Downes and Mr. Komline on the Plainfield installation. Since 1938 this unit has been operating with complete satisfaction on a digested sludge of 15 percent solids content. The apparatus will be known as the Komline-Sanderson Sludge Drier and Furnace.

In order to make complete installations on solids handling, the concern has been licensed to utilize the (1) Wright Cord Filter, and (2) materials handling equipment of the Gifford-Wood Company, Hudson, New York.

In operation, thickened sludge is sprayed into the drying chamber by a special high-speed centrifugal atomizer and subjected to hot gases from the furnace. The dried material settles to the floor, from which it is continuously removed, while the spent gases are vented by the fan. The action of the atomizer in breaking the solid sludge into droplets permits rapid evaporation of moisture from the solid particles. This rapid evaporation in turn quickly cools the gases so that the sludge does not overheat. The resulting fine, dried powder may be bagged for use as humus, or made into a complete fertilizer; or it may be burned in suspension as fuel in processing additional sludge. *(Add to Chap. 6, Sewerage Manual.)*

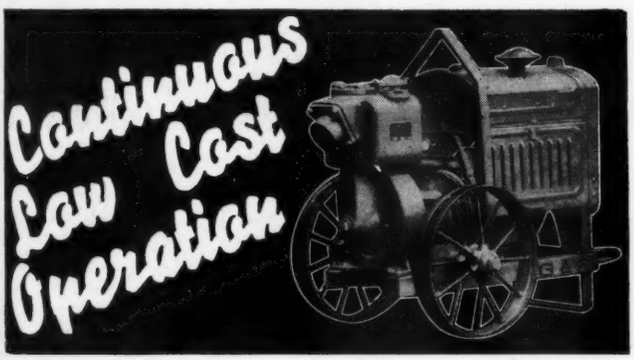
Pioneer 46-VE diesel electric duplex crushing and screening plant operated by Colorado Constructors, Inc., Denver, Colo.

Pre-Cast Concrete Manhole Reduces Cost

To reduce the cost of manhole construction, the Universal Concrete Pipe Co., Columbus, O., has worked out with consulting and Franklin Co. engineers, and the contractor, methods of precasting manholes. The base is poured in place. The riser is made of reinforced concrete pipe, in necessary combinations of 3-ft. and 4-ft. lengths. The lid is precast of reinforced concrete and provides for bricking up to grade over the opening to use a standard manhole frame and cover. A prefabricated ladder is hooked over the lid and grouted in place. These standard manholes can be adapted to any size of sewer.

Automatic Automobile Parking Device Saves Space

Drastic savings to auto park operators in space, handling and building construction are claimed by the manufacturers of a new, fully automatic parking device now being demonstrated in Los Angeles. Marketed under the trade name of Park-O-Mat, this device completely eliminates handling and driving cars either by the garage attendant or car owner, and makes profitable use of narrow lots in congested areas that cannot be utilized for parking at the present time. Further details may be obtained by writing Park-O-Mat, Inc., 3855 Wilshire Boulevard, Los Angeles 5, California.



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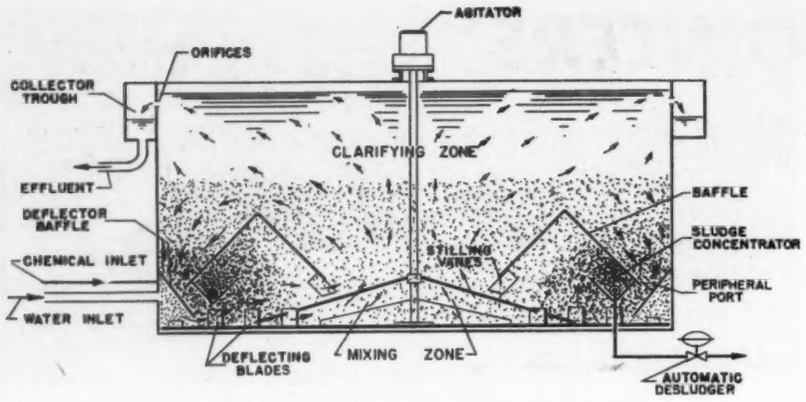

Contact sludge reactor, Liquid Conditioning Corp.

A Better Clarifier for Turbid Water

Filtration alone is insufficient to clarify a water containing appreciable turbidity or color. In such cases, coagulation by means of chemicals which form jelly-like precipitates or "floc" to entrap or absorb the finely divided impurities must precede filtration.

The apparatus in which coagulation takes place must provide for agitation of the chemicals and water followed by separation of the water from the precipitates. To assure maximum effectiveness of clarification in the least time, with greatest economy of space and chemicals, Liquid Conditioning Corporation of New York has developed the Liquon sludge contact reactor. This unit combines the operations of mixing the raw water with the coagulating chemicals, agitating the mixture, maintaining a suspended deep sludge bed or blanket of previously accumulated precipitates, completely separating the clarified water from the sludge, and concentrating the impurity-saturated sludge for minimum volume of blowoff. This sequence of operations is shown in the drawing.

The Liquon sludge contact reactor is equally well adapted for coagulation of turbid, colored waters, for softening of hard well waters by lime-soda, for simultaneously softening and clarifying hard river waters, and for removal of iron, manganese, silica or fluorides from water. Further information on the unit and its application to specific requirements, can be obtained from Liquid Conditioning Corporation, 423 West 126th Street, New York 27, N. Y.

A Front End Material Spreader

This is a new kind of material spreader, especially adapted to applying cinders for street and airport safety, and street maintenance, and similar work. It will spread hot or cold cinders, chip rock, sand, calcium chloride, lime, etc. It carries 4 yards of sand or 10 yards of cinders and distributes 25 to 100 yards per hour from spreading widths of 4 to 20 feet. It has its own power unit. It is built for all standard make trucks. Write for more details to C & F Machine Works, 645 University Ave., St. Paul 4, Minn.

National Clay Pipe Manufacturers Meet

More than 100 clay pipe manufacturers and officials, members of National Clay Pipe Manufacturers, Inc., of which E. K. Sheffield is president, attended a meeting at Cincinnati on September 13, to discuss the industry's part in the national building program. In this discussion, manufacturers pointed out that production of vitrified clay pipe is at its highest point in history. Even greater production was forecast to assist not only veterans' housing, but to build new factories in which they will work and to provide municipal sewage facilities for the increase in urban areas brought about by new housing.

Manufacturers also discussed standardizing specifications on perforated pipe and flue lining and improving them on extra-strength pipe. Fred Cresswell, manager of NCPMI, with offices in Washington, reviewed trends and told how the association is helping the government with sewerage and drainage problems.

News of the Manufacturers

Anthracite Equipment Corp. has moved from 101 Park Ave., N. Y., to the new Anthracite Institute Building, Wilkes-Barre, Pa., but will continue to maintain an office in New York.

Builders Iron Foundry, Providence, R. I., has formed a new affiliate, Builders-Pacific, Inc., with offices at 921 University Ave., Berkeley, Cal., and 2085 Belgrave Ave., Huntington Park, Cal. Lee H. Chamberlain is president and general manager of the new corporation; Harold W. Leeson will handle the Los Angeles office. The firm will also represent Walker Process Equipment Co., Aurora Pump Co. and the Ludlow Valve Mfg. Co.

Graders and Rollers.—Catalog 290 describes the new Galion 102 motor grader, the largest and most powerful motor grader ever made by Galion; 28 pages. Catalog 288 describes the Galion 402 light-duty motor grader, designed especially for counties, townships and villages. Catalog 295 describes the new Galion portable roller, which is especially valuable for patch jobs, driveways, alleys, parking lots, etc. Write to Galion Iron Works & Mfg. Co., Galion, Ohio, for any or all of these.

Beaumont Birch Co., 1505 Race St., Philadelphia, Pa., specialists in bulk handling equipment, have purchased the complete line of Hagan steam jet ash conveyors from the G. J. Hagan Co. of Pittsburgh.

The Calcium Chloride Association has moved its offices from the Penobscot Bldg., Detroit, Mich., to the LaSalle Bldg., 1028 Connecticut Ave., Washington, D. C. Managing Director George H. Kimber and his staff moved to Washington in the latter part of September, terminating 14 years at the Detroit address.

The Permutit Co., manufacturers of water conditioning apparatus, has acquired the Simplex Valve & Meter Co., Philadelphia. H. W. Foulds, president of Permutit, succeeds W. H. Roth as president of Simplex and Mr. Roth becomes chairman of the Simplex Board.

Walker Process Equipment Co. is a new organization in the sanitary engineering field, but its personnel are well-known. The president of Walker Process Equipment Co. is J. D. Walker, formerly vice-president and director of engineering for American Well Works. Associated with him are A. W. Nelson, Douglas E. Dreier, Chester A. Obma, John R. Sperry and Frank Voris. The offices of the new organization are at 33 Hoyt Place, Aurora, Ill.

J. D. Walker

J. Frank Sims has been made sales manager of Meili-Blumberg Corp., New Holstein, Wisc. Mr. Sims was formerly with the International Harvester Co., the WPB and Contractors Machinery Co., Batavia, N. Y.

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Speed Concreting at Low Temperatures

38. 64-page manual tells how to speed concreting, to secure high early strength and greater workability at temperatures either below or above freezing. 60 photos, charts, graphs and tables. Calcium Chloride Assn., Dept. P.W., LaSalle Bldg., Washington, D. C.

How to Make More Durable Concrete at Low Cost

50. How cement dispersion assures improved concrete with impressive economies in initial construction costs and maintenance costs. Manual from The Master Builders Co., Dept. P.W., 7016 Euclid Ave., Cleveland 3, Ohio.

Solve Your Drainage Problems This Easy, Permanent Way

70. Standard corrugated pipe, perforated pipe and MULTI-PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses. 48-page booklet, No. 12. Armco Drainage and Metal Products, Inc., Dept. PW., Middletown, Ohio.

Portable Generator Invaluable For Power Tools, Floodlights

80. Completely new line of portable Gasoline-Engine-Driven AC or DC Generators described in new Bulletin L-406. New models. New, wider uses. Many special features. Uses include battery charging, emergency standby, etc. Address: Homelite Corp., Dept. P.W., Port Chester, N. Y.

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110. Powerful self-contained gasoline hammers illustrated in new booklet. Used as paving breakers and spike drivers. Easily portable, economical. Write Syntron Co., 660 Lexington, Homer City, Pa.

Methods of Installing Steel Sheet Piling

112. Illustrated descriptions of both standard and interlock corrugated steel sheet piling of minimum weight, maximum strength, ease of handling with methods of installation are contained in a booklet. If you have a job involving piling write Caine Steel Co., Dept. P.W., 1820 N. Central Ave., Chicago 39, Ill.

Reliable Pumps for Every Purpose

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

You Can See This Pump In Action on Your Own Job

122. To find out how well a Homelite Self Priming Pump handles large volumes, seepage, mud, write today for illustrated Bulletin L-501 containing data of great value to all pump users. Homelite men will demonstrate it anywhere. Write Dept. P.W., Homelite Corp., Port Chester, N. Y.

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429. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog P.W. issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend 23, Ind.

STREETS AND HIGHWAYS

Data on All Types of Bins and Batching Plants

11. Good illustrations and useful data on all types of Heltzel Highway Bins, for truck mixer charging, bulk cement plants, enclosed bucket elevators, belt conveyors, etc. Heltzel Steel Form & Iron Co., Dept. P.W., Warren, O.

Is Paving Your Bottleneck? Get This Helpful Information

16. Moto-paver is a new type self-contained travelling asphalt plant having a capacity of 100 to 120 tons per hour. A novel spreading and laying device permits quick change to various road widths and crown conditions and thicknesses. Write Hetherington & Berner, Dept. P.W., 729 Kentucky Ave., Indianapolis 7, Ind. for Bulletin MP46 which gives full descriptions and specifications.

Handle All Kinds of Tough Grading Jobs Economically

98. The Austin-Western 99M Power Grader with its powerful all wheel drive handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow ploughing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Dept. P.W., Austin-Western Co., Aurora, Ill.

Levels Sidewalks and Curbs Quickly and Easily

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee 10, Wis.

How to Build and Maintain Roads With Tarvia

111. New "Tarvia Manual" is packed with useful data on how to build and maintain roads with Tarvia. Each step is illustrated with excellent action pictures, 64 pp. 103 illus. Write to The Barrett Div., 40 Rector St., New York 6. N. Y.

Got an Earth Moving Problem?

126. Write Gar Wood Industries, Dept. P.W., Wayne, Mich., on their Two and Four Wheel Scrapers, Bulldozers, Tamping Rollers, Winches, Hoists and Repair Towers.

Speed Your Work With These Powerful Motor Graders

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Strong, Speedy, Low-Cost Maintainer Has Many Uses

130. BG Maintainer, a powerful speedy, low-priced machine for light road maintenance. Full details in illustrated folder. Huber Mfg. Co., Dept. P.W., Marion, Ohio.

Want High-Service Low-Cost Roads?

150. "High-Service, Low Cost Roads" sets forth the principles and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., Dept. P.W., 40 Rector St., New York 6, N. Y.

What You Can Do With Calcium Chloride

152. Complete information dealing with Calcium Chloride Stabilized Roads. Contains many charts, tables and useful information. Write Dept. P.W., Columbia Chemical Div., Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh 19, Pa.

How to Build Better Roads With Calcium Chloride

188. How sub-soils can be conditioned to resist softening and frost-action; how surfacing can be consolidated to provide smooth all-weather riding surfaces; how they can be maintained so as to prevent disintegration and gravel loss. Write the Calcium Chloride Association, Dept. P.W., LaSalle Bldg., Washington, D. C., for Bulletin No. 29.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

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It's No Trick to Clean Sewers This Modern Way

386. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boulevard, Los Angeles 34, Calif.

How Cities Can Do Complete Sewer Cleaning From Street

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

Get These Facts About New Vari-I-Feeder

398. There is a new 16-page illustrated booklet on accurate chemical feeding, describing the Var-I-Feeder, which every waterworks, sewage works and swimming pool man will want a copy of. For yours, just address: Chemical Feeders Division, Morse Boulger Destructor Co., 205P East 42nd St., New York 17.

Power for Sewage Plants As Low as 2¼c Per KWH

411. Full information on how you can use Climax engines with sewage gas for developing power around the sewage plant. Ask for bulletin P.W. Climax Engineering Co., 111 W. Monroe St., Chicago, Ill.

How to Combat Corrosion In Your Gas Holder

412. A 16-page bulletin gives detailed information on the development of corrosion—and how to combat it—in gas holders. A copy will be mailed on request to The Stacey Bros. Gas Construction Company, 5535 Vine St., Cincinnati 16, Ohio.

Make Low-Cost Electricity From Cheap Fuel

422. New booklet describes Sheppard Diesel Generating Sets that make low cost

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Sealed bids or proposals will be received by the City of Hollidays Cove, West Virginia, until twelve o'clock (12:00) noon, Eastern Standard Time, December 16, 1946, at the Office of the City Clerk, 125 Cove Road, Hollidays Cove, West Virginia, for the following work:

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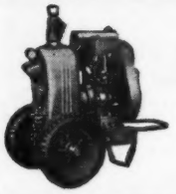

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How to Make Better Sewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

How to Estimate Quantity Of Joint Compound Needed

450. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Here's Data on All Kinds of Pumps

458. Performance data and illustrations on all kinds of pumps for all uses. Address: Dept. P.W., American Well Works, Aurora, Ill.

Save Trucks and Labor In City Rubbish Collection

459. For saving trucks, labor, and time in city rubbish collection get details of the new Dumpster-Kolector described in literature just published by Dempster Brothers, Inc., 996 Higgins, Knoxville 17, Tenn.

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Incineration From the Commonsense Standpoint

462. "Disposal of Community Refuse by Incineration" is a handsome 34-page booklet that discusses incineration from a commonsense standpoint. Illustrated by numerous photos of typical installations and includes diagrammatic outlines of various plant designs. Write Morse Boulger Destructor Co., 207-P East 42nd St., New York 17, N. Y.

An Incinerator Necessity

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Dept. P.W., Plainfield National Bank Bldg., Plainfield, N. J.

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467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Ask for This Design Data On Sprinkling Filters

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Look Into This Sewage Treatment Equipment

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Glazed Clay Blocks for Trickling Filter Underdrains

492. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National fireproofing Corp., Pittsburg 12, Pa., for free copy.

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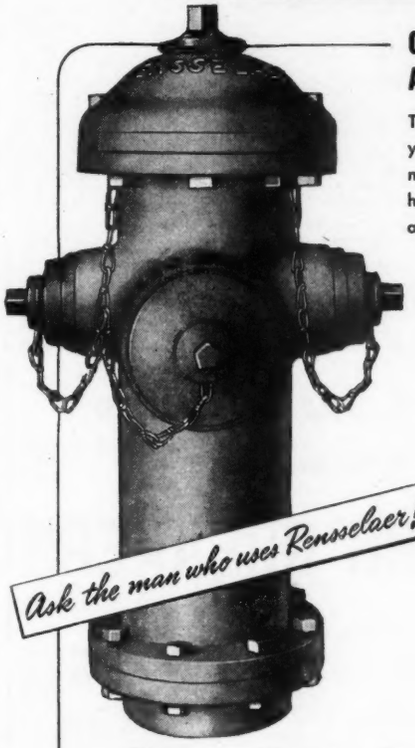

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389. For all water tank maintenance troubles, whether the need is for repairs, painting, welding, or cleaning, get latest literature of Chicago Tank and Bridge Co., 618 Empire Bldg., Rockford, Ill.

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407. Hydrants and Valves. Catalog P. W. covers fire protection appliances, including hydrants, gates and check valves. Catalog also describes sluice gates, shear gates, and flap, mud, gate, check and foot valves. Address: Mueller Company, Chattanooga, Tenn.

The Hydrants With Knuckle Joints

408. Fire Hydrants. "Defender" hydrants of 4" and 5" sizes with knuckle joint horizontally moving valve, easily removed for repair. Send for big new catalog P.W. Rensselaer Valve Company, Troy, N. Y.

All About Flow Meters

409. The primary devices for flow measurement—the orifice, the pitot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (No. 300). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia 42, Pa.

All Types of Valves, Hydrants And Fittings

413. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Aniston, Ala.

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423. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. An 88-page booklet. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

It's Easy to Use This Leak Locator

426. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P., Reading, Mass.

Find Your Leaks In a Jiffy

427. For tracing buried pipes and finding hidden leaks get detail of Allen-Howe Leak Detectors, Pipe Locators, Dipping Needle and Pipe Phones. Ask for new circular P.W. 6, Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

How to Select Main Line Meters

432. New bulletin illustrates Builders Air Relay system for liquids containing suspended solids like sewage. Eliminates corrosion, clogged pipes, etc. "The Selection of Main Line Meters," a highly informative and useful presentation, describes forms of differential producers and quickly solves typical problems with the use of graphic charts. Write Builders-Providence, Inc., Dept. P.W., 9 Codding St., Providence 1, R. I.

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434. "Watchdog" water meters, made in standard capacities from 20 GPM up; frost-proof or split case in household sizes. All parts interchangeable with present models of same manufacturer. For latest bulletin P.W., write Worthington-Gamon Meter Co., Harrison, N. J.

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436. Handbook of Universal Cast Iron Pipe and Fittings, pocket size. 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., Dept. P.W., 386 Fourth Ave., New York 16, N. Y.

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442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere. N. J.

Makes Underground Pipe Installations Easy

444. One-man-operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117, Greenlee Tool Co., 2042 Columbia Ave., Rockford, Ill.

Interesting Facts About Transite Pipe

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., Dept. P.W., 22 East 40th St., New York 16, N. Y.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Have You a Deep Well Pumping Problem?

455. Peerless deep well pumps in a variety of types, with oil or water lubrication and any power drive, to pump water from any depth are subject of special bulletins. Write Peerless Pump Div., Food Machinery Corp., 301 W. Ave. at 26th St., Los Angeles 31, Calif.

Oil or Water Lubricated Turbine Pumps

456. Oil lubricated turbine pumps with open impellers. Five types of heads available. Specifications and illustrations in new bulletin 6930M-2 issued by Fairbanks Morse & Co., Dept. P.W., 600 So. Michigan Ave., Chicago 5, Ill.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Eliminate Taste and Odor From Your Water

474. Technical pub. No. P.W. 207 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination. Sent free to any operator requesting it.

How the Hydro-Treator Works

486. 28-page catalog describes and illustrates the Dorrco Hydro-Treator, a self-contained water treatment unit combining Flocculation, Sludge Thickening and Clarification. Reduces treatment time and lowers plant construction costs. The Dorr Co., Dept. P.W., 570 Lexington Ave., New York 22, N. Y.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

How to Use Alum for Coagulation

502. Alum for coagulation in both sewage and water plants is the subject of literature now available from Dept. P.W., General Chemical Company, 40 Rector St., New York 6, N. Y.

Pittchlor for Water Treatment

503. Get your illustrated booklet P.W. now on *Pittchlor*, a high test calcium hypochlorite, containing minimum 70% of available chlorine. Address, Pittsburgh Plate Glass Co., Columbia Chemical Div., 5th Ave. at Bellefield, Pittsburgh 13, Pa.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

SNOW FIGHTING

For High-Speed Snow Removal

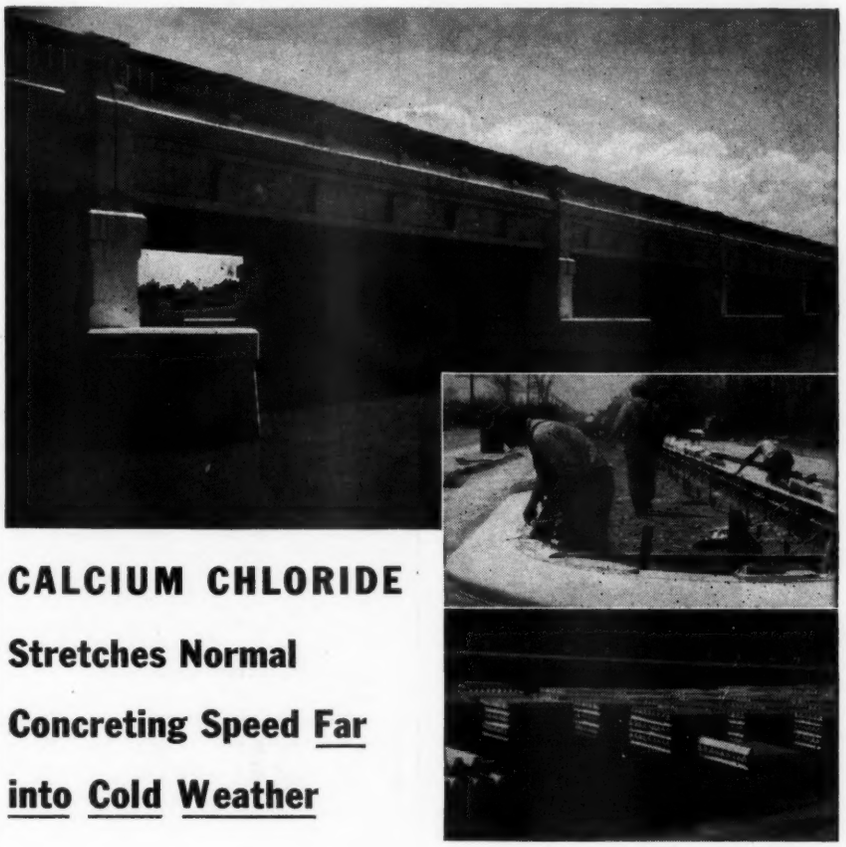
350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

End Dangerous Ice Hazards

354. Ice Prevention on Highways, Streets, and Airport Runways with Sterling "Auger Action" Rock Salt. Illustrated bulletin P.W. issued by International Salt Co., Inc., Scranton, Pa.

Fast, Efficient Skid-Proofing

355. Get full facts about Baughman Light-Weight Cinder Spreaders, fast operators for cinders, sand, salt, chips, etc. Free flowing at low temperatures. 9-17 cu. yd. cap. Write Dept. P.W., Baughman Mfg. Co., Inc., Jerseyville, Ill.



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Hundreds of varied concreting jobs face municipal and highway engineers. For them, cold weather always comes too soon to complete all the curbs and culverts, bridges, patchwork and odd jobs.

Calcium chloride in all concrete placed at 50° F. or below will work wonders in completing cold weather work on summer schedules. It provides required strength in half the time needed without its use.

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We want to dove-tail the facilities of our manufacturing department with your plans for 1947.

Early deliveries of MURDOCK Hydrants, Outdoor Drinking Fountains and Street Washers are contingent upon early placement of orders.

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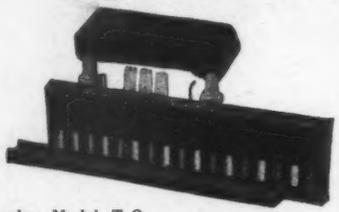
MURDOCK

"LOCK-LID" STREET WASHERS 3/4" and 1" SIZES

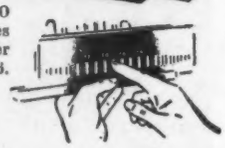
SELF-CLOSING ANTI-FREEZING HYDRANT

ANTI-FREEZING COMPRESSION HYDRANT

LARGE ANTI-FREEZING HYDRANTS 1/2" TO 2" INCLUSIVE



Taylor Model T-O Comparator. Slides available to cover range 0.2 to 13.6.



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7304 YORK RD. • BALTIMORE-4, MD.

PERSONAL NEWS

Robert L. Streeter has opened an office in Casper, Wyo., for the general practice of civil, sanitary and municipal engineering.

Malcolm Pirnie Engineers is announced as a partnership, with Mr. Pirnie's associates including Ernest W. Whitlock, Robert W. Sawyer, G. G. Werner, Jr., and Richard Hazen.

William J. Orchard, General Manager of Wallace & Tiernan Co., Inc., was awarded honorary membership in the Federation of Sewage Works Association at the Toronto meeting. This is the highest honor available to Federation members; and if anyone ever earned it over and over again, it has been Mr. Orchard.

William R. Mullee, formerly in charge of industrial engineering, American Hard Rubber Co., a member of the WPB and one of the faculty of Rutgers, has been appointed Professor of Administrative Engineering, New York University.

Robert D. Evans, formerly of R. G. LeTourneau, Inc., has joined the sales development division of Caterpillar Tractor Co., Peoria, Ill.

Thomas H. MacDonald, Commissioner of the Public Roads Administration, has been awarded the Medal of Merit, highest civilian award, for his war-time services.

Sanitary Engineering Committee Recreated by National Research Council

During the war, the National Research Council, at the instance of the Sanitary Engineering Division of the Surgeon General's Office created a Sanitary Engineering Committee which was of tremendous help in meeting many of the problems arising during the war. This committee passed out of existence last June 30. A post-war committee has now been formed to meet peace-time problems. Members are: Abel Wolman, chairman; Ray Lawrence, Harold Whittaker, W. A. Hardenbergh, W. V. Tiedeman, Gordon Fair and K. E. Maxcy.

JOBS AVAILABLE

Sanitary engineer grade P-4, needed by the Utilities Division, Air Transport Command, Gravelly Point, Va. Qualified men may write C. W. Saunders, chief of the division at the above address.

The State Dep't of Health, Santa Fe, N. Mex., is receiving applications for sanitary engineers (chief, $300 to $400; associate, $250 to $300).

For information regarding a position as civil engineer with Milwaukee County, salary $275 plus $65 cost of living bonus (effective 1 Jan.) write Thomas Cosgrove, 303 Court House, Milwaukee, Wis.

Industrial hygiene engineer, starting salary $337. Write Dr. A. V. Nasatir, Dir. of Industrial Hygiene, 116 Temple St., Los Angeles 12, Calif.

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When you can place a large number of truck bodies at needed points for trash and rubbish depositories . . . when you can pick them up loaded, at regular intervals, in a few seconds, with only one or two truck hoisting units for hauling and dumping . . . you're cutting costs deep compared to conventional truck methods. That is the Dempster-Dumpster system. Five different types of bodies are recommended for most effective service. Two of them, the water tight and Pyramid types, are shown here.

You'll find the Dempster-Dumpster system clean, sanitary, faster and simple. No complicated equipment is involved. Equipment investment is reduced which includes reduced maintenance costs. Our engineers will be glad to consult with you upon request.

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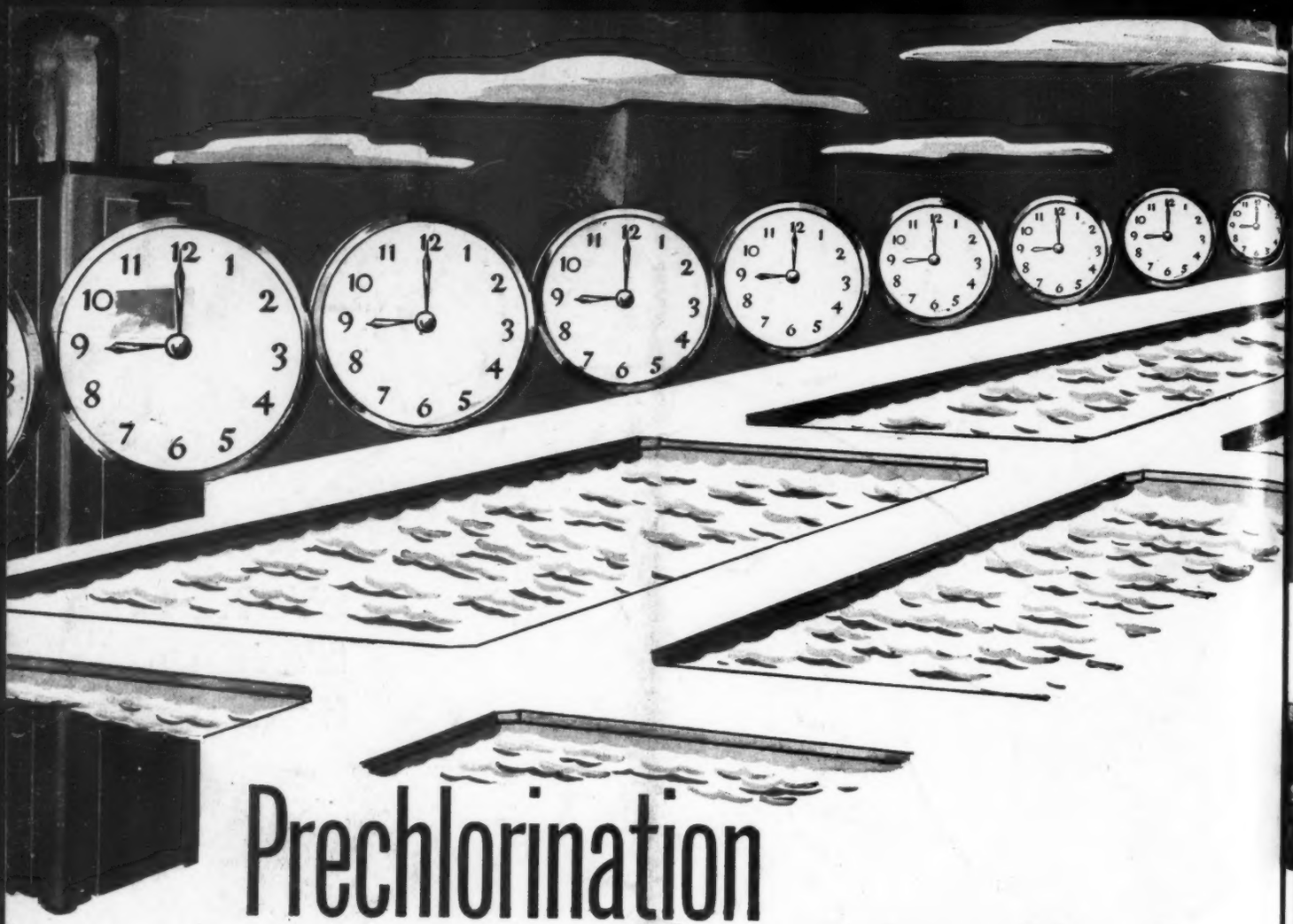

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